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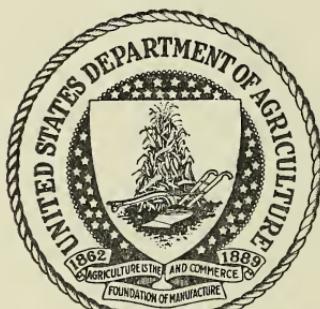
U.S. OFFICE OF EXPERIMENT STATIONS.

Foods, human nutrition, and other home
problems.

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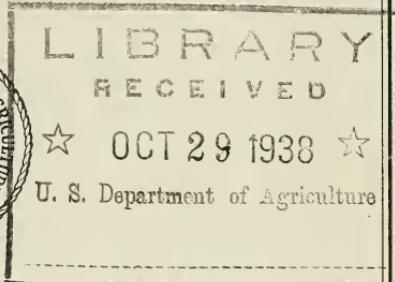
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UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF EXPERIMENT STATIONS

FOODS, HUMAN NUTRITION,
AND
OTHER HOME PROBLEMS

Reprint from Report on the Agricultural Experiment Stations, 1937 (1E76)



UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1938

FOODS, HUMAN NUTRITION, AND OTHER HOME PROBLEMS

As has been emphasized in early reports of this series, the problems of the home are largely those of consumption and are concerned mainly with questions of quality. The producer is also concerned with quality of his products but is learning that quality which pays is no longer that of outward appearance alone but also that which makes the greatest contribution to the health and welfare of the human being. Through research the housewife too is being taught the same lesson and being aided to develop sound and reliable standards of quality in consumer's goods and services. Some of the contributions of the experiment stations during the past year of direct benefit to the home along these lines are noted below.

QUALITY IN FOODS

The housewife thinks of quality in foods in terms of the foods themselves—meats, poultry, eggs, and milk; bread, cake, and pastry; and fruits and vegetables—rather than in terms of the specific factors affecting quality. For this reason selected examples of the work of the year in the field of quality will be reviewed under specific foods.

Meats.—The best conditions for the care of meat in the household refrigerator have been very thoroughly studied by the Iowa Station using ice and electric refrigerators, all kinds of meats commonly stored in this way for family use, various containers and wrappings, and different times and temperatures of storage. All samples were tested for shrinkage, appearance, and signs of spoilage after storage, and some were cooked and judged for flavor. Cooked roasts were returned to the refrigerator for further storage. The greatest losses in weight occurred with uncovered samples and the least with those wrapped in paraffin or parchment paper or kept in a covered container. Cooked roasts cooled before being returned to the refrigerator showed greater shrinkage than those returned without being cooled. As far as appearance and general palatability were concerned the products wrapped or kept in closed containers were for the most part preferable to those stored uncovered, but spoilage took place rather more quickly. It was concluded that cooked roasts may be stored satisfactorily for 2 or 3 days at temperatures of 48° F. or below when wrapped or covered, but that for longer periods the meat should be left unwrapped or wrapped very loosely in paraffin paper and kept at temperatures below 45°. Unwrapped hams stored at such temperatures were satisfactory after a 2-week period, and sausages in cases wrapped loosely in parchment paper, for from 7 to 8 days. Seasoned ground sausage meat similarly wrapped was most desirable if kept not longer than 48 hours and ready-to-serve meats, from 24 to 48 hours. Steaks frozen and stored in the freezing unit of the electric refrigerator were more palatable if covered or wrapped during storage and cooked without defrosting.

Freezer storage of farm-produced meats for family use has raised many problems of the handling and cooking of the frozen product.

At the Minnesota Station a study has been made of the effect of different thawing temperatures (175° , $24\text{--}25^{\circ}$, and $2^{\circ}\text{--}4^{\circ}$ C.) on the time of cooking and quality of various cuts of pork and beef which had been wrapped in moisture-proof paper and left in a freezing cabinet at -18° C. (0° F.) until frozen solid. For thawing at the higher temperature the meats were unwrapped, the roasts placed in an electric oven preheated to 175° , and removed when the thermometer registered 5° , the steaks thawed under the broiler flame with the oven regulator set at 175° , the chops seared on each side in a frying pan, and the pot roasts seared and simmered in water until a skewer could be forced through. For the lower temperature the meat was left until thawed in the laboratory or in a conditioning room ($24\text{--}25^{\circ}$) and in a mechanical refrigerator ($2^{\circ}\text{--}4^{\circ}$). Roasting was done at constant temperature, 175° , according to the standard method of the cooking committee of the cooperative meat investigations. The roasts which had been frozen cooked more quickly than the unfrozen, and those thawed at the higher temperature more quickly than those thawed at the lower temperature. The total losses were somewhat higher for the roasts thawed at the high temperature than for those thawed at the lower temperature or for the unfrozen meat. The press fluid (or juiciness) of the frozen pork thawed at $24\text{--}25^{\circ}$ was higher than the unfrozen pork. Flavor, tenderness, and juiciness as measured by palatability tests were not affected by freezing or thawing at either of the temperatures.

A short-time study along similar lines was made at the Illinois Station, with freezing for 48 hours at temperatures of -10° , 6° , and 10° F. and thawing temperatures of 39° (electric refrigerator), 54° (ice refrigerator), about 81° (room temperature), and for comparison nonfrozen and frozen but not thawed similar cuts. For the roasts a preliminary searing at high temperature was followed instead of the constant-temperature method used in the Minnesota study. The palatability of the frozen and nonfrozen meats ranked about the same except that the frozen pork scored higher than fresh for tenderness and juiciness. The samples which had been thawed before cooking were given a slight preference over those which had been cooked without thawing. Losses in weight during thawing and during cooking did not vary significantly for the different methods tested. Considerable differences were noted in the time required to cook thawed and unthawed meats, the unthawed always requiring more time than the thawed. The maximum time which frozen meats could be safely kept after removal from frozen storage was 2 to 3 days in an ice refrigerator and 3 to 4 days in an electric refrigerator, depending on the thickness of the pieces.

In the 1936 report on the stations attention was called to the use of the meat thermometer to replace guess work in the roasting of meats, and preliminary studies at the Texas Station were noted in which it was shown that the less tender a cut the better chance it has for becoming tender on roasting if a low oven temperature, 125° C. (257° F.), is used instead of a high temperature, 225° C. (437° F.), provided the roasting is continued to a definite internal temperature as registered on the meat thermometer. The secret of this, according to further reports from the Texas Station, appears to be the longer time required by the less tender cuts to reach the same internal temperature. With chuck roasts of beef, for instance, the temperature

goes up fairly rapidly for a while and then there is a long lag when there is almost no change in the thermometer reading. With a tender rib roast of beef the rise in temperature is more uniform and with lamb there is practically no lag. If a low oven temperature is used the cooking time is longer for all roasts than with a high temperature, but the difference is much more marked with the less tender than with the tender cuts, 370 minutes for chuck, 194 minutes for beef rib, and 105 minutes for leg of lamb. According to the Texas investigation more work needs to be done before anyone is able to recommend processes of cooking which will uniformly produce tender roasts. Present knowledge would indicate, however, that a housewife will have a better chance of obtaining a tender roast if she cooks it at a low than if she cooks it at a high oven temperature.

Which is preferable, a standing or a rolled beef rib roast? The Minnesota Station has attempted to answer this question by preparing standing and rolled two-rib roasts from the right and left cuts of the same animal, roasting them at constant oven temperature 149° C. (300° F.) to the same internal temperature 58° C. (137° F.) and judging them according to the score card of the cooking committee of the cooperative meat investigations as well as taking the usual records of evaporation, dripping, and total cooking losses. The standing roasts had a larger quantity of juice with correspondingly lower total losses, and required less total cooking time and minutes per pound than the rolled roasts. The scoring showed that there was a slight tendency for the standing roasts to have a richer quality of juice than the rolled, but there was no consistent difference in flavor.

The effect of cooking upon the composition and serving value of four cuts of beef—prime rib, chuck, top round, and heel of round—was studied by the Missouri Station with calculations of the total cost of servings of each. The meats were all roasted at constant temperature of 150° C. to the underdone, medium-done, and well-done stages. With a few exceptions increase in doneness caused an increase in the moisture, fat, and total ash of the drippings, and a very slight increase in the protein. The cooked cuts were all richer in protein, fat, and total ash than the corresponding uncooked cuts, but not to an equal extent in all of the cuts. Considering the original cost of the meat, the cost of the gas consumed, and the number of servings obtainable per pound of uncooked meat, the heel of round cost 6.2 cents, the chuck 6.7, the prime rib 8.9, and the top round 10.6 cents per serving. These figures are of interest, of course, as relative rather than absolute costs.

Top shoulder clod, rib, and top and bottom round of beef were selected by the Kansas Station for a study of the composition of certain cuts as affected by grade, location in cut, and method of cooking. The cuts were boned, and all but the clods rolled before cooking, which was done by roasting at a constant temperature of 150° C. to internal temperatures of 71° – 78° . The bottom round and one of the clods were braised, or cooked in a small amount of added water in a covered roaster on top of the stove.

As in the Missouri study, considerable variation in composition was found not only among the various cuts but also in different grades of the same cut and in different locations of cuts of the same grade. All the cuts showed increase in protein and fat and a decrease

in moisture after roasting but the percentage increase in protein was higher and in fat lower in the rib than in the leaner cuts. As a result, the amount of protein in the rib cut after cooking became comparable with that of the lean cooked top round ordinarily regarded as a more abundant source of protein.

The influence of the condition of the ewe on the cooking quality of mutton has been studied by the Missouri Station for the purpose of giving reliable recommendations for the choice of the animal for slaughter, of cuts from a given animal, and of methods of cooking. Cuts from fat ewes proved more satisfactory than from thin ones, for they gave less evaporation loss, required less gas and less time per unit weight to cook, were superior in tenderness, juiciness, and desirability of flavor of lean, and gave a higher percentage of edible meat from legs, shoulders, and chops, and a lower percentage of meat suitable only for ground loaf. As for selection of cuts, legs and shoulders rather than chops are recommended when cooking losses, fuel consumption, serving value, and all factors of palatability except tenderness are considered. Large pieces are preferable to smaller ones from standpoint of cooking losses, time, and fuel required per unit of weight. If cuts from thin animals only are available, ground meat is most economical on account of the higher percentage yield of edible meat. Drippings from ground meat especially should be used in gravy to improve the flavor and juiciness of the loaf. Oven temperatures recommended are 150° C. for legs and ground loaves, 175° for shoulders, and 175° after a searing period for chops.

Potatoes.—As noted in the 1936 report, much attention is being given at several of the experiment stations to factors affecting the cooking quality of potatoes. Many of these factors, such as the conditions under which potatoes are grown, are beyond the control of the housewife, but she can play some part in furnishing her family with potatoes of desirable quality, in the matter of selection, storage, and cooking methods.

In a study at the Vermont Station of quality demands in household buying of various foods the investigator came to the conclusion that housewives are apt to buy potatoes without either looking them over or asking for specific qualities. In a much more extensive study conducted by the New York (Cornell) Station in two large cities the housewives who were observed in the stores likewise did not seem to be discriminating in their buying, since a large percentage asked for potatoes with no specification of the qualities desired. When these purchasers were interviewed in their homes and asked what qualities they desired in potatoes more than half mentioned mealiness. When asked what qualities were avoided as much as possible those mentioned most frequently were the poor qualities usually considered in the proper grading of potatoes, too large or too deep eyes, too large or too small potatoes, and external defects. A demand for grading in potatoes would simplify the housewife's task in potato selection.

Since mealiness is the physical quality most desired in potatoes, several of the stations are continuing their attempts to find a satisfactory method for judging mealiness. Among these is the New York (Cornell) Station, which is making a definite effort to replace subjective tests by objective ones, using several pieces of apparatus de-

veloped for the purpose. One of these, known as a slot-extrusion tester, distinguishes between mealiness and sogginess by the load required to force the cooked potato through a 50-micron slot. A relation between the mealiness of a cooked potato and its specific gravity in the raw state has been noted by the Ohio Station. The ease with which a loaded needle (penetrometer) penetrates into a cooked potato has frequently been used to determine doneness in potatoes, but, as recently shown by studies at the Colorado Station, this test does not necessarily indicate mealiness in spite of the fact that there is a relationship between starch content and mealiness and between starch content and penetration. Although these studies seem very technical and far removed from practical advice to the housewife in the selection of potatoes for the table, they are mentioned as showing the efforts which are being made to find some measure of cooking quality in potatoes which can be applied in their grading, thus doing away with the rather unsatisfactory method of buying by sampling and cooking to determine quality.

In the Colorado studies referred to above, it was observed that in boiled potatoes those of high starch content which have been cooked until they taste done, as determined by a mellow rather than crisp feel to the tongue as well as a distinct difference in flavor, will be much more solid than those of low starch content. As the cooking is continued beyond the "done" stage the potatoes become progressively softer. It is, therefore, fortunate that the starch content of a potato is highest in the outer portion, since in cooking this portion is maintained at a high temperature for a longer period of time than the center portion. If the distribution of starch were reversed the potato might differ considerably in hardness in the various portions, even though it tasted done. Possibly the poor cooking quality of potatoes which tend to slough before they are done in the center may be due to poor distribution of the starch.

If potatoes are raised on the farm for home use or bought in quantities, storage conditions during the winter become a factor affecting quality. To determine the importance of this factor the Montana Station selected two outstanding commercial varieties raised in the State, the Bliss Triumph and the Russet Burbank, or Netted Gem, and two contrasting types of storage cellars—one a regular potato storage house in which temperature, humidity, light, and ventilation were under proper control, and the other a vegetable room in a private house, with no control of temperature and humidity and a single north window for ventilation and light. The storage house was described as "cool and damp," with temperature ranging from 37° to 46° F., and the home vegetable room as "warm and dry," with temperature ranging from 55° to 60°. The potatoes were placed in storage October 1 and at the end of 6 months were subjected to various tests including cooking tests for palatability and biological tests for vitamins B and C, with a few chemical tests for C.

Both varieties kept in the cool damp cellar remained firm throughout the entire storage period and showed only slight evidence of sprouting by the first of May. Those kept in the warm dry cellar gradually withered, and the Bliss Triumph began to sprout in January and the Netted Gem in April. The flavor of the Bliss Triumph was better in the samples stored in the cool damp cellar and of the Netted Gem in the warm dry cellar. The Netted Gem also developed

a greenish-yellow color in the cool cellar. This was not associated with a high solanine content, for both varieties kept in both storage places increased in solanine content as storage progressed. A difference in varieties of potatoes with reference to the effect of storage was also shown by the Ohio Station, which found that Russet Rurals seem to deteriorate less in cooking quality during storage than the Green Mountain variety.

Because of the importance of potatoes as an inexpensive source of vitamin C, the Montana Station has determined by the rapid chemical method the vitamin C content of potatoes cooked in a variety of ways. With one exception the Bliss Triumph potatoes always contained more vitamin C in a given weight than the Netted Gem. When cooked by ordinary methods, baked potatoes ranked highest in vitamin C, followed by steamed, boiled, and pressure-cooked. After storage there appeared to be somewhat less loss of vitamin C in the potatoes kept in warm dry than in cool damp storage. In general, servings of cooked potatoes in the spring after storage in the cool damp cellar contained about two-thirds as much vitamin C as in the fall.

It is well known that potatoes which have been stored at too low a temperature accumulate sugar from a break-down in starch and that such potatoes are particularly undesirable for frying chips, as shown by earlier work of the Maine Station and also of the Department of Agriculture (B. H. E.). It is possible to recondition such potatoes to some extent by holding them for a time at a higher temperature, but this is not always feasible. Approaching the problem in a different way the Minnesota Station found that chips of good quality can be prepared from potatoes which have developed a high sugar content in storage by changing the temperature and time of frying. As the sugar content of the potato increases, the frying temperature (or temperature at which the crisping and browning occurs after the water has evaporated) must be decreased and the frying time correspondingly increased. In the laboratory work the sugar content was determined by testing with picric acid. Potato slices giving a red color with this reagent made desirable chips when immersed in fat at a temperature as low as 325° F. (163° C.) and fried at 270° F. (132° C.). The Burbank variety, which with picric acid never tested above a deep orange, made good chips at an immersion temperature of 365° F. and a frying temperature of 290°.

Soybeans.—Quality studies on soybeans as human food, particularly in the so-called green-vegetable state, are continuing at several of the experiment stations in cooperation with the Department of Agriculture (B. P. I.). At the Illinois Station alone more than 450 varieties and selections have been cooked by standard methods and scored for palatability and other factors. From these 17 superior ones have been chosen. These are described as attractive green vegetables when immature and large light-colored beans when dry, quite different from the field soybeans now being grown. There is considerable prejudice to be overcome in the acceptance of soybeans as a human food, but properly selected varieties not too strong in flavor offer great promise in both the green-vegetable and dried state. The Indiana Station reports a very favorable response from farm families using soybeans cooked in different ways and states that either

green or dry edible soybeans may be canned although they need longer processing in the pressure cooker than snap beans. The Alabama Station has found that the yellow- and green-seeded light-colored soybeans have a much more attractive appearance when canned than the dark-colored varieties of soybeans or the usual varieties of cowpeas used so extensively in the South.

Food value as well as palatability has also been given attention in soybean studies. Aside from moisture content which, of course, decreases as the beans mature, there is little difference in the proportion of the various food constituents from the time the green beans are ready for table use until they reach the dry-bean stage, according to tables of composition prepared by the Illinois Station. Wide variations in content of carotene, the vegetable source of vitamin A, were found by the Alabama Station in different varieties of soybeans and these variations could not be predicted from the depth of yellow color in the dry beans. Compared with other beans, however, they are as a class a good source of vitamin A. All in all, soybeans are a good vegetable crop to consider for the farm garden. One point in their favor, according to the Illinois Station, is that they are ready for use as a green vegetable in September when vegetables are none too plentiful. Another argument in their favor, suggested by the Indiana Station, is that the crop is highly resistant to the Mexican bean beetle and withstands drought well.

Lima beans.—In work at both the Massachusetts and New York State Stations fresh green lima beans were found to be an exceptionally good source of vitamin C, comparing favorably with orange juice and richer than green peas and tomatoes. With the many factors which, as pointed out in the 1936 report, tend to destroy vitamin C during the interval between harvesting and eating the product, it is of interest to trace these losses in such a good source of vitamin C as lima beans and see to what extent they may be avoided. According to the New York State Station the original vitamin C content varies rather widely with variety and size. When graded according to size the large-seeded pole varieties were found to be richer in vitamin C than the large-seeded bush varieties. When beans of a single variety were graded according to size, the smaller beans in the lot contained a higher percentage of vitamin C than the larger ones. When stored in the pod after picking, the beans retained their original vitamin C content very well, but when shelled the loss was much more rapid. Even when kept in moistureproof packages, the shelled beans lost about twice as much of the vitamin as beans in the pod. This loss is one that can easily be avoided by the housewife through demanding unshelled rather than shelled beans in the market, or picking and shelling them just before cooking if the supply comes from the home garden. Another point to remember is that the loss of vitamin C is much less at refrigerator than at room temperature.

In preparing shelled lima beans for frozen storage the New York State Station found that approximately one-third of the vitamin C was lost during the blanching in boiling water according to the recommended commercial blanching time of 150 seconds. A much shorter time (45 seconds for the small sizes and 60-75 for the larger sizes) was found adequate to prevent the development of off-flavors

and loss of color in the frozen product during storage and is worth considering in the preparation of lima beans for refrigerator-locker storage. Frozen beans showed no loss in vitamin C if sufficiently low temperatures were used for freezing and storing. In the New York State Station study the blanched beans, after being quickly cooled in running water, were drained and packed dry in moistureproof cartons, quick-frozen in a Birdseye Multiple Froster, and stored at -17.8° C. (0° F.). In recommendations from the Oregon Station for refrigerator-locker storage freezing temperatures of -5° to $+5^{\circ}$ F. with storage temperature the same or not to exceed $+15^{\circ}$ are given.

Sweet corn.—This vegetable is used so extensively in the canned, and more recently also in frozen state, that factors affecting its quality are particularly important. Several of the experiment stations are studying varieties and strains especially adapted for canning from the standpoint of yield and vitamin A content (yellow varieties), while others are particularly concerned with the food value, especially vitamin C, as affected by methods of preservation. The housewife is interested in quality standards for commercially canned and frozen corn and in the best methods of preserving sweet corn for winter use in the home.

The well-known association of vitamin A with yellow pigment has been one of the factors responsible for the popularity of Golden Bantam corn in regions where it can be grown successfully. With the development of many hybrids of this popular sweet corn the question arises as to their vitamin A value. Although this point does not seem to have received particular attention in experiment station research, studies at the Illinois Station of various hybrids of yellow field corn have shown that depth of yellow color is not always a clue to the vitamin A content of the cured corn, some varieties of a pale yellow color having more carotene, the plant source of vitamin A, than others of a deeper color. However, in more recent work at the same station the darker kernels of the same ear were found richer in carotene than the lighter.

Golden Bantam was the variety used chiefly by the Massachusetts Station in an investigation of the stability of vitamin C in sweet corn in shipping, freezing, and canning. Values of 40 to 60 international units per ounce were obtained with raw, fresh cooked (cut or cob), frozen, and whole-grain corn of this variety. Among other findings of interest to the housewife are the following: Sweet corn picked early in the season had a somewhat higher vitamin C content than that picked late in the season. Market corn compared favorably with freshly picked corn. After 24 hours' storage in the husk at room temperature the loss in vitamin C was less than 10 percent and after 4 days, less than 50 percent. Exposure of canned sweet corn, after opening the can, had little effect on the vitamin C even after 3 days' storage in the refrigerator at 40° F. Complete defrosting of frozen corn at the same temperature required 24 hours and resulted in only about 3 percent loss of vitamin C, while complete defrosting at room temperature resulted in only a 6-percent loss. The loss in vitamin C in heating sweet corn—fresh raw, frozen, or canned—until ready for the table was slight, amounting to less than 9 percent. Cream-style canned corn contained a little less vitamin C than whole kernel and this in turn than vacuum-packed. In general, canned

sweet corn sold in the market was found to be a fairly good source of vitamin C, with some brands equal in value to fresh sweet corn. All in all the vitamin C in sweet corn seems to be much more stable than in lima beans.

Golden Bantam corn was also selected by the Montana Station for a study of the effect of different methods of home preservation—canning, drying, salting, and fermenting—on keeping quality, palatability, and vitamin content. The records of spoilage in the canned corn processed by different methods and for various times furnish convincing evidence of the folly, to say nothing of the danger, of attempting to can nonacid vegetables by any other method than the pressure cooker. With necessary modifications in pressure for the high altitude, about 5,000 feet, there was no spoilage in the corn processed in the pressure cooker for 90 minutes at 240° F. and for 70, 75, and 80 minutes at 250°. Processing for 70 minutes at 250° is recommended to the housewives of the State as a safe method to follow. Spoilage in corn canned by water-bath, steam, and oven methods varied from 36 to 100 percent.

Of the other methods tested, salting gave the most satisfactory product, ranking higher in palatability scores than canned corn. The method followed consisted in packing in a stone jar alternate layers of salt and cut corn in the proportion of 1 to 4 or 7 parts, covering it with a weighted cover, and letting it stand for 2 or 3 weeks and then removing to clean glass jars and sealing. The corn for this method and for drying was precooked on the cob for 8 or 10 minutes before cutting. The dried corn was prepared by spreading similarly treated corn in thin layers and drying in a well-ventilated oven at from 100° to 150° F. Fermented corn was prepared by covering corn cut from the cob without preheating with a weak vinegar-salt brine and letting it stand for 2 or 3 weeks in a warm place and then transferring to clean glass jars and sealing. The dried, salted, and fermented corn kept very well if handled as suggested. With dried corn the greatest chance for spoilage came from souring during the drying process and was controlled by drying as rapidly as possible without overheating. With the salted and fermented corn the tendency to mold was reduced by transferring the material at the proper time to glass jars and sealing.

Rather unexpected results were obtained in the vitamin A tests, for the cooked fermented corn was twice as effective, the canned corn half as effective, and the dried and salted corn just as effective as the raw frozen corn. All forms of the preserved corn were less effective as a source of vitamin B₁ than the raw corn, the loss being particularly marked in the fermented corn. The same stability of vitamin C in corn prepared in different ways was noted as in the Massachusetts Station when the vitamin content was determined chemically, but in a few guinea pig feeding tests the canned corn was only half as effective as the raw frozen corn.

Cabbage.—Many housewives will welcome the news that the New York (Cornell) Station has succeeded in developing a cabbage that has practically no odor, for if it were not for the somewhat unpleasant odor which permeates the house when cabbage is being cooked even by the most approved methods, this inexpensive vegetable would probably have wider use. The new odorless cabbage, which has been named Cornell Early Savoy, is described as "uniformly well crinkled,

dark green foliage; heads of medium size, light green in color, semi-pointed, very crisp and succulent. Exceptionally fine for cooking."

Cabbage has always been highly regarded as a source of vitamin C with the distinction that raw cabbage is preferable to cooked because of its higher content of vitamin C. With the development of quick chemical tests for this vitamin it has been possible to make finer distinctions concerning the quality of cabbage with respect to vitamin C under different conditions. The New York State Station reported:

The varieties of cabbage commonly grown for harvesting early in the summer are much higher in vitamin C than those usually cut late in the autumn for kraut manufacture and winter storage. Whole heads of raw cabbage slowly lose vitamin C during storage. The rate of loss of ascorbic acid [vitamin C] is much higher at ordinary room temperatures than when the cabbage is stored under refrigeration. During the cooking of cut cabbage a considerable proportion of its ascorbic acid is dissolved in the cooking water. Approximately one-fourth of its vitamin C content is lost in the first few minutes of cooking. After that the loss is slight. Even though cooked cabbage is placed in a very cold refrigerator, it slowly loses its ascorbic acid, and at the end of two days' storage approximately only one-half of its vitamin C content remains.

Tomatoes and oranges.—From a nutritional point of view the chief interest in tomatoes is in their vitamin C content, for they are one of the most readily available and inexpensive sources of this vitamin. It was first thought that oranges and tomatoes had about the same vitamin C values. Later it appeared that tomatoes were only about half as rich as oranges in this vitamin. More recent work, as noted in the 1936 report on the stations, has shown that certain varieties of tomatoes are very much richer in vitamin C than others. This has been confirmed in an extensive series of tests at the Massachusetts Station of varieties and strains grown under identical soil treatment and care on the station experimental plats. In the 98 varieties or strains tested the values ranged from a low of 0.13 milligram to a high of 0.44 milligram per gram. This shows that one variety may be from two to three times as rich as another in vitamin C.

Freshly extracted orange juice (eight varieties) has been reported by the Department of Agriculture (B. H. E.) to have a vitamin C content ranging from 0.32 to 0.62, and by the Montana Station (two varieties), from 0.39 to 0.62 milligram per cubic centimeter. In comparison with this range of 0.32–0.62 milligram per cubic centimeter 20 of the tomato varieties tested by the Massachusetts Station had values of 0.32 milligram per gram or above. In other words, tomatoes may be as rich in vitamin C as certain varieties of oranges. Different strains of the same variety of tomato in some cases showed as wide variation as was found between different varieties. Consequently, advice cannot be given as yet as to the selection of tomato varieties for the home garden for the best yield of vitamin C, although the averages for the different strains give some indication. Various strains of a new variety being developed at the station gave an average vitamin C content of 0.37 milligram per gram as compared with 0.32 for the Comet, 0.31 for the John Bair, 0.29 for the Bonny Best, 0.27 for the Marglobe, 0.25 for the Rutgers, and 0.21 milligram per gram for the Pritchard. The station is of the opinion that "with a little care, the canners of tomatoes and tomato juice should be able to select and perfect improved strains of tomatoes of higher vitamin C potency."

than are now grown commercially." This was suggested in the 1936 report as possibly accounting for the wide differences now existing in the vitamin C potency of different commercial brands of tomato juice.

Other points brought out in this Massachusetts study were that there is no relation between the size of a tomato and its vitamin C content; that degree of ripeness has no significant effect on the vitamin C content; and that so long as the fruits remain firm and sound the vitamin C content will not be seriously affected during shipment, in markets; or in canneries.

As noted above, oranges as well as tomatoes have been found to vary considerably in their content of vitamin C. The Florida Station has traced the concentration of vitamin C and acid in ripening oranges through and beyond maturity and has found that both vary with the physiological age of the orange. In a later ripening variety (Valencia), both vitamin C and acidity decrease with maturity, while with early (Parson Brown) and midseason (Pineapple) there is an increase in vitamin C up to maturity, followed by a decrease. The station also found that a high concentration of vitamin C within a variety is associated with a high-quality juice, but that a juice ranked as of poor quality does not necessarily have a low concentration. Storage tests at ice-box temperature (40° F.) have shown that an increase in concentration of vitamin C up to 30 percent may occur (although not always) in the first few weeks of storage.

Miscellaneous.—Meat, potatoes, soybeans, lima beans, sweet corn, cabbage, tomatoes, and oranges have been singled out for special attention to illustrate, with a few of the more common foods on which considerable work has recently been done, the type of research at the experiment stations which is gradually improving the quality of agricultural food products and establishing standards by which quality may be judged. Attention should be called to one or two general publications of the year which are of unusual value in summarizing work along this line of interest and value to the housewife who is concerned with quality in foods. One of these, a contribution from the Massachusetts Station (B. 338) discusses each vitamin in turn with the effect of such factors as maturity, storage, freezing, heat, and drying on its stability in different fruits and vegetables. Although the bulletin is not confined to experiment station research, at least 21 of the experiment stations are included as sources of the information given. To the housewife the summary is of particular value in telling in general terms what steps to take to conserve the original vitamin values of the food she selects and prepares for the family table.

A publication of special interest to the rural housewife in localities where refrigerator-locker storage is available for home-produced foods is a circular (No. 122) from the Oregon Station. According to this publication refrigerator lockers are increasing by the thousands annually, and housewives are eager to utilize such storage facilities to preserve foodstuffs. They are cautioned, however, that fresh fruit or vegetables used for freezing should be of the highest quality; and as maturity affects the flavor, the stage of maturity should be watched. Green or overripe fruit should not be used because the products will be flavorless when "defrosted." Overmaturity in vegetables will mean a very tough

and stringy product, the flavor and appearance also changing with age. The best stage of maturity for eating or other use in the fresh stage is also the best condition for freezing.

This advice is followed by information on proper temperatures and general methods of preparation and specific methods for a number of fruits and vegetables. Most useful to the housewife, however, are the final frozen-pack tables which summarize for each fruit and vegetable the method of preparation, type of container, and method of packing.

Starches and flours.—The quality of many cooked desserts depends greatly upon the thickening power of starches. Why is it sometimes difficult to get a smooth paste when starch or flour is used for thickening? Why does a pie filling sometimes refuse to thicken and a molded pudding fail to set? These are only a few of the questions investigators at the Illinois Station are attempting to answer in their starch studies which have been noted in previous reports. The observation that starches are seldom used in food preparation in the total absence of sugar, salt, and such ingredients as milk or fruit juices, both of which contain salts, led to a study of the viscosity, or slowness of pouring of starch pastes with or without added sugar and ordinary table salt. Wheat-starch paste was found to have a lower viscosity than cornstarch and the latter began to swell and increase in viscosity at lower temperatures, demonstrating why cornstarch rather than wheatstarch is usually used in cooking. When only as much sugar was added to the starch paste as would be used in a slightly sweet pudding there was a considerable increase in the viscosity of the starch paste heated to about 80°, but when as much sugar was added as would be the case with a very sweet pie filling or similar mixture the paste became much less viscous. The addition to starch paste of very small amounts of one of the salts present in milk, potassium citrate, increased the viscosity, showing that milk plays some part in the thickening of custards and milk puddings. The beneficial effects of small amounts and harmful effects of large amounts of sugars and salts on the appearance of starch-containing desserts was also shown by the ability of the cooked paste to gel. Both corn- and wheat-starch pastes containing 10 percent sugar held their shape well when turned out of molds after cooling, but those containing 60 percent of sugar, or not much more salt than might be used for seasoning, flattened out.

Some of the difficulties in starch cooking are thus shown to be due to the use of too much sugar or salt. Much of the responsibility for the quality of home-made cakes and breads rests with the miller and is beyond the control of the housewife. The contributions of the experiment stations to milling problems and baking technology are of indirect help, however, in so far as they result in improvement in blends and treatment of flour, in commercially baked breads, and even in new baking formulas which can be used in the home as well as the laboratory. At the Illinois Station a study of the effect of five different bleaches on the cake-baking qualities of a patent grade of soft-wheat flour made from certified Fulhio wheat showed that the bleached flours gave superior products to the unbleached as judged by home-baking standards, and that one of the bleaches improved the quality of the flour much more than the others. If atten-

tion is paid by flour millers to these findings, better products will be assured to the home cake baker as well as to the trade.

Housewives who have attempted to use honey in place of sugar in cake making have met with varying degrees of success. In a study at the California (Davis) Station to determine the conditions under which satisfactory cakes can be made with the replacement of some of the sugar in the ordinary recipes by honey, it was found that the natural acidity of the honey, which varies widely with different types, accounts for some of the trouble experienced. Star Thistle honey, which was the first one tested, may be used in a basic plain-cake recipe up to 50 percent of total sweetening if the amount of the liquid ingredient is adjusted, and in even higher proportions if the acid in the honey is neutralized with baking soda. The amount of honey that may be used will depend largely on the acidity, for too much soda will affect the flavor of the cake. Cakes made with honey have the advantage over cakes made with sugar in keeping moist longer.

Attention was called in the 1935 report on the stations to the altitude baking studies at the Colorado Station which have resulted in the derivation of an equation for determining the correct proportions of ingredients for an angel food cake which can be used at any altitude. An extension of this work to the mixture for sponge cake has shown that for this more complex mixture containing the additional variable fat, a single equation will not apply in all cases. The equations finally developed hold for specific amounts of egg and flour at each elevation and with sugar as the variable constituent.

In experimental bread-baking tests for flour quality factors influencing the oven spring of dough are considered of importance. As this is also true in the home baking of bread, some of the findings in a study at the Montana Station of oven spring of dough, as influenced by sugar, salt, and yeast, may be applied in home baking. Only one of the seven flours tested had the greatest oven spring when no sugar was used in the recipe. All of the others gave the best results with 1 percent of sugar. When as much as 5 percent of sugar was added, all doughs were sticky during the customary manipulation and the crusts were too dark. Moderation in sugar appears to be a good rule to follow in bread as well as custard making. With three flours at least 1 percent of salt was needed for maximum oven spring, while with others 1.5 to 2 percent of salt was required for the best results. The doughs without any salt and those with 3 percent or more of salt were all sticky during mixing. The action of yeast was retarded in doughs from four of the flours with as much as 3 percent of salt. Three of the flours gave the best oven spring with 1 percent of yeast and the others with 5 percent, although in several of these the sugar had become used up, as shown by too light a crust color, at the time the dough was baked.

Nearly all bread formulas are based on the use of compressed yeast, which is not available on isolated farms and ranches. For this reason a study was undertaken by the Wyoming Station to determine the best formula for bread making in high altitudes, using Wyoming hard-wheat flour and dried yeast cakes. During the course of this study it was found that even dry yeast cannot be kept for several months with good results and it was suggested that the poor quality of much of the bread baked in rural homes is due to using dry yeast

that is too old. Dry yeast is more or less dormant and must be allowed to stand for 14 to 16 hours either in a ferment or starch of potato flour and water or a sponge of flour, milk, and a little salt before mixing into dough. With Wyoming hard spring wheat flour better results were secured with the sponge than the ferment method. A temperature of 80° to 85° F. proved satisfactory for the fermentation of the dough, which was allowed to rise to three times its bulk in the first period and two and one-half times in the second and third periods.

To encourage the use of whole-wheat bread in Wyoming rural homes the station also carried on baking tests with various proportions of white flour and whole-wheat flour of medium, fine, and coarse granulations. A light loaf could be made from the finer whole-wheat flour with the addition of 55 to 60 percent of white flour, but with cracked wheat more of the white flour was required. A somewhat lower baking temperature and longer time of baking were required than for white bread.

QUALITY IN NUTRITION

For many years the experiment stations have conducted research on the nutrition of farm animals—feeding tests to produce cows, pigs, and sheep of better quality and research on small experimental animals to determine what are the factors responsible for health and freedom from disease in livestock. Some of the findings in research on small animals are applicable to human beings as well as animals, just as some of the findings in small-animal research carried on in various places throughout the world for the primary purpose of improving the health of human beings has been found equally applicable to farm animals. However, until fairly recently, experiment stations have not been concerned with problems of human nutrition as studied on human beings as subjects aside from dietary surveys to determine the adequacy, according to the accepted standards of the moment, of the diets of rural people in their respective States.

The last few years have seen a growing interest in this field of research on the part of a few of the stations, as has been noted in previous reports of work at the Arizona Station on mottled enamel, a problem solved by work on both animals and humans; studies at Ohio University, the Wyoming Station, and elsewhere on the basal metabolism of human beings of different ages; the series of studies at the Oklahoma Station on the nutritional problems of pregnancy, and the extension of the work of the Wisconsin Station on nutritional anemia from rats and pigs to humans. Of even greater significance in showing increased interest in human nutritional problems is the development of three regional cooperative projects, each of which is participated in by several of the stations under formal memoranda of agreement.

The first of these cooperative projects, entitled "The Nutritional Status of College Women," is located in the North Central States, with participation by the Iowa, Kansas, Minnesota, Nebraska, and Ohio Stations and the University of Wisconsin. The second of these projects in the Northeast and the third in the Northwest both deal with vitamin C metabolism and requirements. In the former the Maine, Massachusetts, New York (Cornell), and Rhode Island Sta-

tions are participating and in the latter, which was formally organized in October 1937, Oregon, Washington, and Utah Stations are already taking part, with the probability of two other stations joining.

In these three cooperative projects, already involving 13 States with others probably joining later, the subjects are women students at the land-grant institutions. Probably the majority of them are from rural homes. Consequently the investigations will show on a scale so large that the conclusions drawn from them will be generally applicable (at least in the region where the separate studies are being made) what is the present nutritional status of girls of this age from rural homes and along what lines improvement is needed. In the North Central States project, which is on a larger scale than the other two, the work covers basal metabolism, essential to determine the energy requirements of the diet and useful in detecting abnormalities in metabolism pointing to disturbances needing medical attention; blood studies, including among other things tests which will throw more light on the iron requirements of subjects of this age; complete dietary records to show what the girls are actually eating; and metabolism studies, necessarily in a much smaller number, to determine whether or not the freely chosen diets of these girls are adequate in such essential food constituents as nitrogen, calcium, and phosphorus. At the very beginning of the work various body measurements are taken which will be of help in interpreting the other data to be collected. The group of investigators at work on this extensive project have already discussed their preliminary findings, but nothing as yet has been published from the joint investigation.

Much of the important research on laboratory animals, chiefly the rat, for the ultimate purpose of solving human nutrition problems is difficult to understand until its final application in diet recommendations. In the experiment station research programs there are many investigations which give promise ultimately of being applicable to human nutrition, but which at present are in the stage of requiring faith and imagination to see their human application. Because of the magnitude of the nutrition research program with small animals, a single illustration only will be given of investigations still in the small-animal stage, another of investigations begun with small animals and now extended to human beings, and still another showing the logical development of research on a single problem through the laboratory stage, the application of laboratory discoveries to human beings, and finally the practical solution at least on a small scale of a problem of great significance in certain areas of the country.

Nutritional cataract.—Following the discovery about 2 years ago that mature or markedly advanced cataracts invariably occur in rats fed a laboratory diet containing excessively high levels of lactose (milk sugar) as the sole source of carbohydrate, the Massachusetts Station has continued the investigation in the hope of throwing some light on the cause of so-called senile cataracts in human beings. In the first experiment lactose was fed at the excessively high level of 70 percent of the diet. Later similar cataracts were produced in a much shorter time in rats fed a similar diet with galactose (the sugar formed on the break-down of lactose) as the sole source of carbohydrate at a level of 50 percent of the diet. When the amount of galactose was reduced still further to 35 and 25 percent of the diet, amounts corresponding

to the galactose which would be formed from lactose at 70- and 50-percent levels, again cataracts resulted in a very much shorter time than on corresponding amounts of lactose. These differences, together with the negative results obtained when other sugars (xylose and fructose) and starch were used in place of lactose or galactose, were thought to prove that galactose is the chief cause of this type of cataract.

The Massachusetts investigators next attempted to find out whether any other changes in the diet would either prevent or hasten the appearance of the cataracts. All sorts of changes were made without the slightest effect until it was found that a reduction in protein from the regular 15-percent level to a 5-percent level shortened the time of cataract development very noticeably, the effect being greater than an increase in the galactose level from 25 to 35 percent. This finding seems of particular interest in view of the fact that senile cataract develops at a time of life when the usual diet recommendations and common practice point to a lowering of the protein of the diet. However, the research workers on this problem are proceeding with caution and as yet are making no comparison with human diets.

Nutritional anemia.—The history of the discovery by the Wisconsin Station of the relation of copper to iron in the formation of hemoglobin and the prevention of secondary or nutritional anemia has been summarized in previous reports. With the proportion of iron and copper required for optimal hemoglobin regeneration in depleted rats now fairly well established, it has been possible to study the effect of other factors on hemoglobin formation. In a study at the Wisconsin Station of the effect of nine different proteins on the rate of hemoglobin regeneration in anemic rats supplied with adequate iron and copper, it was found that when the dietary protein was either qualitatively or quantitatively inadequate for growth hemoglobin regeneration was greatly retarded. Among the effective proteins were those of liver, casein, egg albumin, and soybean meal and the ineffective corn-gluten meal, wheat gluten, and gelatin.

With liver playing such a vital part in the treatment of penicuous anemia, there has been some uncertainty as to whether its effectiveness in simple nutritional anemia is due solely to its iron and copper content or possibly to some other factors in addition. To answer this question the Wisconsin Station fed anemic rats various commercial preparations of iron, or iron and copper combined with whole liver or liver extracts, at levels sufficient to supply 0.5 milligrams of iron daily. As thus adjusted, the various preparations proved equally effective, showing that their hemoglobin-regenerating efficiency was due solely to their iron and copper contents.

During the course of a study at the Arizona Station of the hemoglobin-regenerating value of various foodstuffs, it was observed that hemoglobin regeneration was greater in the females than in the males fed at the same levels of iron intake up to 0.2 milligram daily, above which the difference between the sexes was less apparent because the iron intake was large enough to promote maximum regeneration in all of the animals. While at the time the Arizona investigators were interested in this sex difference primarily because it pointed to the necessity of using animals of one sex only in testing the hemoglobin-

regenerating potency of any food material, more recent observations afford an explanation of this difference between the sexes, which is of particular interest in view of the use which the female may be called upon to make of her iron reserves. Feeling that sufficient attention had not been given to the provision of plenty of copper to use up all of the iron reserves in the body of experimental rats when they are being prepared for anemia studies, the Arizona investigators supplied additional copper during the depletion period on milk and found that under these circumstances there was much less difference between males and females in their response to iron and copper feeding. This finding was thought to indicate that part of the sex difference previously noted was due to a greater store of iron in the female of the same hemoglobin concentration. Perhaps the lower hemoglobin levels of the blood of women than of men on the same diet is due to the need for greater reserve stores of iron by females than by males.

In the 1936 report of this series the preliminary results were noted of an extension of the Wisconsin anemia work to infants. In the complete report of this study the conclusion was drawn that anemic infants respond better to iron supplemented with copper than to iron alone. During periods of infection the administration of medicinal iron and copper was found to be ineffective. Recovery from infection must occur before iron and copper medication is of any value. Healthy well-fed infants with sufficient reserves of iron and copper were found to maintain an average level of from 11.5 to 12.5 grams of hemoglobin per 100 cubic centimeters of blood throughout the first 2 years of life.

On extending their studies to young college women, the Wisconsin investigators found that, unlike infants, anemic women of this age group responded as well to iron medication alone as to iron and copper. The subjects were chosen on the basis of two or three successively low hemoglobin readings, the average being 11.4 grams per 100 cubic centimeters of blood. In 40 women who were given 25 milligrams of iron daily in the form of ferric pyrophosphate plus 1 milligram of copper as copper sulphate, the hemoglobin values rose to from 12.69 to 13.69 grams, with an average of 13.23 grams per 100 cubic centimeters of blood, while in 35 women receiving iron alone the final values ranged from 12.85 to 13.49 grams, with an average of 13.15 grams per 100 cubic centimeters. In further work with college women, the conclusion was drawn that there are significant daily variations in the hemoglobin levels of normal healthy women, and that a range of from 13 to 15 grams, with an average of 14 grams per 100 cubic centimeters, may be considered as the average hemoglobin of healthy women 20 to 27 years of age.

Preliminary reports of a similar study of women students of the University of Illinois showed a predominance of values under 13 grams before any treatment and of values of 14 grams or more per 100 cubic centimeters after the administration of iron and copper in the same amount as in the Wisconsin study. This would indicate that the small groups of students examined were somewhat anemic. In view of the recent observations at the Arizona Station, it seems quite likely that not enough attention has been paid in considering the iron requirements of women to the demand of the female organism for additional iron for storage purposes.

Mottled enamel.—The story of mottled enamel and the discovery by the Arizona Station of its cause in the fluorine content of the water has been reviewed in previous reports, but with no practical solution of the problem as far as concerns individual homes with a fluorine-contaminated water supply which cannot well be changed. The Arizona Station, not content with discovering the cause, without a practical remedy, for this disfiguring and destructive action on the teeth, has finally succeeded in developing a method which, at a not prohibitive cost, can be used in the home to free the water supply from fluorine, or at least reduce the content below the danger level. The method involves slow filtration of the water through specially prepared ground bones which take up the fluorine as the water passes through. As a practical test of the method, water from the high-school well in a community in Arizona in which all of the native inhabitants have typical mottled enamel, was filtered by gravity through a bottle containing 5 pounds of the prepared bone at the rate of 30 gallons per hour and the filtered water tested for fluorine at intervals. The water at the beginning contained 3.5 parts of fluorine per million, while the danger level is as low as 0.9 part per million. Fluorine tests made after 35 and 70 gallons had passed through showed a content of 0.1 part per million and after 105 and 140 gallons a content of 0.2 part per million, or still well below the danger level. Whether or not the method can be used on a large scale for municipal water supplies has not yet been determined, but it promises to be a godsend for home use.

Vitamin requirements.—While a great deal is now known of the vitamin content of foods, both relatively for the vitamins whose chemical nature has not been determined and absolutely for vitamin C which can now be determined by chemical tests, the exact requirements for human beings are still pretty much a matter of conjecture. Quite recently, however, tests have been developed for two of the vitamins, A and C, which give some indication of the stores of these vitamins in the human subjects being studied and offer promise of being useful in determining requirements. Although these tests did not originate in experiment station research, they are being used in several of the stations, particularly the tests for vitamin C which will constitute a large part of the research under the northeastern and northwestern cooperative projects on vitamin C metabolism (p. 9).

Vitamin A.—The test for the state of nutrition of human subjects with respect to vitamin A depends upon the fact that night blindness, in the absence of any other pathological condition of the eye, is due to insufficient vitamin A. There are now on record many instances of night blindness interfering seriously with ability to drive a car after dark or carry on any work in poor illumination that have been cured by large doses of vitamin A. To detect night blindness an instrument known as the biophotometer is now being used, by means of which the response of the eye to the change from darkness to bright illumination and vice versa can be tested. While there is not complete agreement as to the degree of dependence which can be placed on the test, and it cannot be used for very small children, some rather significant findings have been obtained with the use of this instrument.

One of the first experiment stations to make use of the test was that of Illinois, where the earlier form of the instrument, known as a Birch-Hirschfeld visual photometer, was used in tests on 20 children from low-income families to determine whether carotene, the plant precursor of vitamin A, is as effective as halibut-liver oil in supplying the vitamin A needs of children. In the first tests 17 of the 20 children gave low results, indicating a deficiency in vitamin A. Four of these recovered after from 14 to 26 days on a daily supplement of carotene furnishing 5,000 International units of vitamin A, 3 others showed some degree of improvement, and 10 no improvement during treatment, which varied in length from 7 to 29 days. Many of the children were changed from carotene to halibut-liver oil furnishing comparable amounts of vitamin A but with no difference in results. When the vitamin was increased to 10,000 International units daily in the form of halibut-liver oil, prompt and rapid recovery occurred. As this large amount of vitamin A was given only in the form of halibut-liver oil, there was nothing to indicate that carotene is less effective than halibut-liver oil when administered in amounts furnishing the same number of vitamin A units.

The newer form of photometer known as the biophotometer has been used in an extensive investigation at the Pennsylvania Station of the nutritional status with reference to economic status of all the individual members of entire families. A preliminary unpublished report states that persons of the highest income levels (including families of annual cash income of \$5,000 a year or more) gave significantly higher average readings in the photometer tests than those of all the lower income groups. Although no significant differences were found among these lower income groups taken as a whole, there was found to be a definite relationship between the amount spent for food and the readings, indicating that in general the greater the amount spent for food, the higher the vitamin A intake. A comparison of the dietary records of 50 families showing high vitamin A intake and the same number showing a low intake with the photometer readings of the individual family members showed significantly higher readings for the first group than the second, thus confirming in a general way the value of the test as an indication of satisfactory or unsatisfactory vitamin A nutrition.

In another experiment conducted by the Pennsylvania Station investigators on groups of school children before and after treatment with various vitamin A concentrates, it was found that the children receiving vitamin A treatment in the form of large doses of carotene daily during the winter gave significantly higher photometer readings in the spring than a control group receiving no additional vitamin A.

A preliminary report from the Georgia Station states that of nearly 200 children from the first grade through the sixth who were tested with the biophotometer during the winter months almost half gave readings which were border line or subnormal, while after halibut-liver oil treatment of a large number for a period of 3 or 4 weeks, the values for most showed marked recovery.

In a study still in progress at Purdue University, La Fayette, Ind., on vitamin A storage in young college women, the biophotometer readings on about 100 subjects before vitamin A treatment gave relatively low values for about 20, and definitely higher values for

two subjects (who had been taking vitamin A concentrate), with the others in the range of normality. The subjects with low initial values were then paired, one of each pair receiving no supplement and the other three halibut-liver oil capsules daily. Although there were individual differences in response, the group receiving no supplements showed no consistent improvement at the end of 5 weeks, while the others showed improvement.

From these tests, the biophotometer appears to be of some use in detecting vitamin A deficiency, but as yet a satisfactory method has not been perfected for its use in determining actual requirements.

Vitamin C.—Three methods are in use for determining the body's store of vitamin C—(1) the capillary fragility method, which measures the strength or weakness of the blood vessels either by direct or positive pressure with an instrument similar to the one used by physicians in determining blood pressure, or by indirect or negative pressure with a vacuum cup device, (2) urine tests, which measure vitamin C excretion, and (3) blood tests, which measure the content of the vitamin in the blood stream. The first of these tests has received some attention at several of the experiment stations, particularly Maine, New York (Cornell), and Utah. Probably the most extensive work at any of these stations has been done at the Utah Station where the work was started in an attempt to determine whether any relationship exists between vitamin C deficiency and dental caries. Although no such relationship is apparent as yet, the test as applied to about 400 rural children has shown a tendency to increased capillary fragility in the spring as a sequel to reduced vitamin C intake during the winter.

The capillary fragility test, by the positive pressure technic, has also been applied by the Utah investigators to more than 250 college women students. Of these, 5 percent gave results indicating subnormal vitamin C, while a little over 9 percent were border-line cases. When vitamin C from natural sources, and synthetic or manufactured vitamin C were given to a few subjects who had shown low values, there appeared to be a better response in the capillary test to the natural source of vitamin C than to the synthetic vitamin. If these preliminary findings should be confirmed by further work, it would suggest that capillary fragility is not a result of a deficiency of vitamin C, but of something so closely related to it as to be present in most natural sources of the vitamin. It has already been suggested by Szent-Györgyi, who received the 1937 Nobel Prize for medicine for his research on vitamin C, that such a closely related vitamin does exist.

Fortunately most American diets are not so low in vitamin C or the closely related vitamin P as to make the capillary fragility test for extreme deficiency a practical one in this country. The second of the tests mentioned above is the one in most extensive use in the cooperative research projects in the Northeast and Northwest. Results which have been reported from an institution in each of these regions will serve as an illustration of what can be hoped for when the work develops on the large scale made possible by the coordinated attack on the problem.

About 4 years ago some English investigators discovered that vitamin C is excreted in the urine in amounts varying with the individual

and with the diet, massive doses of vitamin C being followed sooner or later by large increases in the amount excreted. Since then much work has been done all over the world to see whether this test can be used to determine vitamin C requirements. In a study recently reported from Washington State College as preliminary to the more extensive investigation which is now being carried on under the northwestern cooperative project, the amounts of vitamin C excreted daily in the urine of seven college women were determined for varying periods of time with these results.

Two subjects, receiving little or no fruits or vegetables in their diets, excreted 10.58 milligrams and 14.36 milligrams daily; two subjects, whose diets included some fruits and vegetables, excreted 29.32 milligrams and 23.69 milligrams daily, while three subjects with high intakes of fruit juices, salads, and vegetables excreted 42.64 milligrams, 60.23 milligrams, and 83.72 milligrams daily. "Saturation" tests of one massive dose of 600 to 800 milligrams ascorbic acid showed an excretion of 30 percent of the dose only in subjects who were previously excreting 60 milligrams daily while on their regular diet.

These results might be taken as an indication that 60 milligrams of vitamin C daily is the requirement for women of this age, but it is realized by all who have been working along these lines that, as stated in the report of the Washington study, "more subjects, both healthy and suffering from various diseases, need to be studied before any definite statement can be made as to quantitative requirement under varying conditions."

Urine tests are being used by investigators at the New York (Cornell) Station in an attempt to determine vitamin C requirements according to the following plan: Normal adult women are given 200 milligrams of vitamin C as ascorbic acid daily until saturated, as shown by the recovery in the urine within 24 hours of at least half of a test dose of 400 milligrams. Then the subjects are put on a diet containing almost no vitamin C, but supplemented with a small amount daily of the pure vitamin. After several days a large test dose is again given and the response to this is compared with the response after known saturation has been reached. If the response is less than 50 percent of the test dose the experiment is repeated, using a somewhat larger amount as a daily dose. Finally a point is reached when a satisfactory response follows the test dose. With the few subjects thus far studied, a 25-milligram daily dose, which many have considered to be the minimum daily requirement for adults, has been quite insufficient and amounts varying from 50 to 85 milligrams a day have been required.

With the remarkable discoveries which are continually being made in nutrition research and the extravagant claims of much of present-day food advertising, it is often difficult for the consumer to distinguish between propaganda and legitimate claims. The Massachusetts Station has recently rendered a good service to the bewildered consumer in a bulletin (No. 342) which summarizes "information, decisions, and criticisms by recognized authorities concerning nutritional and therapeutic claims in food advertising as well as faulty concepts and notions regarding foods and nutrition." As a final aid a list is given of 10 reliable reference books, the latest editions of which can be depended upon to give up-to-date information on the rapidly growing science of nutrition.

QUALITY IN TEXTILES

Factors affecting the quality of cotton and wool fabrics begin with the fibers from which the fabrics are woven and go on through the manufacturing process to the treatment which they receive in wear and cleaning. The first and last of these factors are receiving attention in a few of the experiment stations. Silk and rayon textiles are also being studied for the factors which in the final material affect wearing quality.

Cotton.—The physical characteristics of cotton fibers are receiving much attention at the Texas Station. The necessity of making many tests of fibers has led to the development in the textile laboratory of the station of improved methods of determining strength and fineness of the fibers. For the former a tiny bunch of fibers is carefully combed, cut to a definite length, and weighed and then fastened between strips of drafting tape such as is used by architects. It is then a simple matter to measure the strength of the fibers by breaking the prepared sample in an ordinary breaking strength machine. Fineness of the fibers can be measured satisfactorily, taking microphotographs of cross sections of the fibers at a high magnification and measuring them with a planimeter. For a single sample of cotton at least 250 measurements were found necessary for accurate results. These studies are mentioned simply to show how very delicate and time-consuming are methods of fiber analysis.

Fabric analysis, although simple in comparison with fiber analysis, requires considerable time and for best results should be done in a special laboratory in which temperature and humidity can be controlled. Several of the experiment stations now have such laboratories, among them Kansas and Minnesota. The effect of bleaching processes on cotton sheeting was tested at the Kansas Station by analyzing several brands of bleached and unbleached sheetings for thread count, breaking strength, kind and amount of sizing, weight per square yard, and whiteness before and after 20 launderings. Some of the unbleached sheetings were subjected to a bleaching process before each laundering until they matched in whiteness the commercially bleached sheetings of the same brand. At the end of the experiment the unbleached fabrics which had received no treatment except laundering were stronger than the bleached ones and those which had been bleached and laundered had about the same strength as the commercially bleached sheetings. However, after several months' storage in a dark closet the commercially bleached samples were still white, while the others had become yellow. To the housewife this means that if whiteness is the quality most desired in sheetings, commercially bleached ones should be purchased, while if strength and consequently longer wear counts for more than appearance, it is best to buy unbleached sheeting and not attempt to hasten the natural bleaching that comes with successive launderings.

Housewives who hesitate to make use of power laundries for fear of greater wear will be interested to learn that in another study at the Kansas Station the power laundry was found to be less destructive than home laundering methods on three-fourths of all cotton materials tested. While the one power laundry involved in the study handled the white clothes more satisfactorily than the home laundry,

it did not prove as satisfactory for colored clothes as there was greater change in color than in the same materials laundered by home methods. The materials in the Kansas study were tested after 20 launderings.

In a special study at the University of Missouri of the effect of several commercial and home laundry methods on five unsoled plain-weave fabrics of the muslin variety, the materials were laundered 100 times with tests after 1, 5, 15, 30, 45, 75, and 100 launderings. Some of the samples were not ironed and others ironed at each laundering with an electric hand iron or an electric rotary iron. The results seem to indicate that the commercial washing methods caused less decrease in the strength of fabrics during the first 15 launderings but more thereafter than did the home methods used. The amount of shrinkage was similar with all methods of laundering. In the commercial process, ironing was responsible for much of the decrease in strength fillingwise. In the home method, after the first few launderings the washing procedure appeared to be more responsible for the strength loss and other changes.

In other studies at the Missouri Station the effect of wear as well as laundering has been determined. Durability tests on 24 night-dresses made from 5 cotton muslin fabrics and laundered after each three wearings and the same number laundered without wearing indicated that the effects of body wear were greater than those of laundering. The signs of deterioration due to wear were greatest under the arms and across the shoulders of the garment and those of laundering greatest along the folds and the edges of the heavy seams. Through the cooperation of homemakers and students, samples of 33 new fabrics and the same fabric discarded because of wear were analyzed. Percales, nainsook, batiste, and voile were the fabrics most frequently represented, although there were a few others. In most of these fabrics the filling (crosswise) strength was much lower than the warp (lengthwise) strength in the new fabrics and also decreased more during wear.

This raises the question why such fabrics are made with the warp threads so much stronger than the filling threads when both the appearance and the strength of the worn-out fabrics show the wear to be much greater fillingwise than warpwise.

The housewife who does a good deal of home sewing would be greatly benefited in the selection of material if she could be given some information on the strength warpwise and fillingwise of the material and other factors affecting wearing quality. The information obtained in this Missouri study explains why the particular fabrics wore out as they did. This and a much more extensive investigation along similar lines to be noted later will make the housewife aware of the qualities textile materials should possess for service, but until such information is available at the time of purchase she will not be able to make the best selection.

A recent investigation at the Arkansas Station contributes the type of information noted above as being greatly needed for a group of cotton materials used extensively for children's clothing. These included six samples of nainsook costing from 11 to 50 cents per yard, seven of broadcloth from 11 to 65 cents, and two of suiting 25 and 29 cents per yard, respectively. The fabrics were purposely selected with

a wide range in cost in order to see if price is a good guide to quality. As brought out in this study—

quality is a broad term that may cover many characteristics of a material. Each particular fabric has its best use. Fine nainsooks for babies' clothes will not serve satisfactorily as material for little boys' suits, yet nainsook and suiting may give excellent service for certain garments. No one fabric is superior to all other fabrics made of the same type of yarn and no one test can be a satisfactory measure of the service that any material may give.

While the most expensive fabrics did not have the greatest tearing and breaking strength, they were lighter in weight, thinner in texture, smoother in finish, and more even in yarn and weave and showed more nearly balanced fabric elongation (or stretching) in the warp and the filling. The low-priced fabrics showed excessive stretching in the filling threads, an undesirable feature from the standpoint of the shape of the garment after laundering and wear. While much of the information obtained in this study is untranslatable to the housewife, the accumulation of data along similar lines will after a time make it possible to set up standard specifications for such goods as a basis for grade or descriptive labeling.

Two types of fabrics in common use for nurse's or house uniforms, poplins and broadcloth, were studied in the textile laboratory at the Minnesota Station to determine which type of material gives the greater service. The poplins proved more satisfactory as a class than the broadcloths because they showed less shrinkage, were more durable as judged by the customary strength tests, and also showed less variability among the various physical characteristics.

Silk.—A garment representing a considerable outlay, with all too little information available about wearing quality, is the "silk" slip. A study at Kansas State College of the effect of actual wear, laundering, and aging on silk slips purchased from six different companies showed that the material of which the slips were made varied greatly in thread count, balance of thread, weighting, tensile strength—all factors affecting quality. The amount of wear, as shown by the same tests after the slips had been worn a given number of hours (525-1,000), varied little in the better slips worn by different individuals, while it varied greatly in slips of poorer quality. This probably means that it is more essential for a woman who is "hard on her clothes" to buy a better grade of slip than for one who perhaps because of a better figure is "easy on her clothes." The deteriorating effect of age was much greater in the more heavily weighted slips. The slips which had been laundered four or five times per 100 hours of wear showed earlier deterioration than those laundered only once in the same length of time.

With laundering an important factor in the wearing out of silk slips, it is of interest to note that in a study in progress at the Minnesota Station on the wearing qualities of silk crepes, such as used for underwear, some evidence is being obtained that the new type of detergent now coming into use as substitute for soap may be less harmful than even a neutral soap for washing silk fabrics. Work is in progress at the Montana Station to compare the effect of the new type of detergent and soap on silk hosiery.

Performance during wear of silk and cotton fabrics.—Realizing that it is only on the basis of large numbers of comparisons of analyses of clothing fabrics with actual performance during wear

that recommendations can safely be made to the housewife as to what to buy to meet certain needs and to the producer as to what qualities are desired for specific purposes, a group of extension and research workers in the Northeastern States in 1935 organized a cooperative project in which six States are now cooperating. The project consists in laboratory analyses, all of which are being done at Pennsylvania State College, of samples of fabrics purchased for women's and children's dresses to be made in the home, and of records kept by the women who make the dresses of the length of time they are worn and the number of times laundered or cleaned. When discarded the garments are sent to Pennsylvania State College for inspection, and the records kept by the women are compared with the life expectancy of the garment as predictable from the analysis of the fabric. To illustrate, two of these predictions taken from the records are as follows:

For a cotton print—

the color fastness of this type of material may be expected to be good except when it is rubbed by another material either wet or dry. The texture is firm, and the material should show durability in the lengthwise direction. It may tear if strained too much in the crosswise direction. It may be expected to shrink about 1 inch per yard in the lengthwise direction and 1½ inches per yard in the crosswise direction. The fabric will probably appear somewhat thinner after it is washed because the sizing is removed.

For a weighted silk—

the color fastness of this fabric may be expected to be relatively poor, except to drycleaning and dry pressing. The strength in the lengthwise direction is good but it is very poor in the crosswise direction, especially when wet, since, in addition, the fabric is heavily weighted. The durability is apt to be unsatisfactory also. Pulling at the seams may show under little or no strain.

The home dressmakers who are taking part in this cooperative project will probably be made very conscious of the need of informative labeling of textile fabrics and perhaps repeated requests for such information will do much to persuade the manufacturers of the wisdom of giving reliable information as to the nature of the goods they wish to sell.

QUALITY IN HOUSEHOLD EQUIPMENT

Whether it be a kerosene, gas, or electric stove, an electric iron, a vacuum cleaner, or utensils large and small for which the housewife wishes the best value for the price she can pay, advice is ready for her in recent experiment station publications.

Kerosene stoves.—Preliminary comparative studies have been made by the Maine Station on five kerosene stoves representing three types of burners—the long-chimney type with wicks, the short-chimney type with wicks, and the wickless, short-chimney type with asbestos lighting ring. Four of the stoves had built-in ovens, of which two had rock-wool insulation, one a single layer of asbestos paper for insulation, and the other no insulation.

According to the studies thus far made, there is opportunity for considerable improvement in the construction of kerosene stoves. The spacing of the burners was such that only two of the stoves could accommodate the use of two utensils with maximum top or bottom diameter of 10½ inches, while with two of the stoves utensils with a 9-inch diameter were the largest that could be placed at the same time on adjacent burners. Another objection to the stoves examined

was the inability to regulate the burners to low heat. This results in unnecessary waste of heat which is undesirable because of overheating the kitchen as well as necessitating the use of excessive amounts of water in cooking.

Gas and electric ranges.—A circular (No. 55) of the Nebraska Station, based on the extensive investigation of the merits of various types of gas ranges in the market noted in the 1936 report, answers most of the questions which any prospective purchaser might ask and gives a rating chart which can be taken to the store and checked in comparing the relative merits of different models. The problem is simplified, according to this circular, by basing the choice upon at least three factors which, ranked in order of importance to the buyer, are price, performance, and construction. The approved seal of the American Gas Association indicates that the model has complied with the requirements of the association's testing laboratory in performance and construction and also in safety. Since the range represents a piece of equipment that will be used for many years in the ordinary home, some thought should be given to its appearance. An enclosed cooking top of adequate size to accommodate several large-sized utensils with lightweight grates which make little contact with the top and small burners set very near to the bottom of the pan means lower operating cost. Because most people cooking with gas tend to use a higher flame than is necessary, a range equipped with a simmer burner has an advantage, particularly for long-time cooking processes. The convenience of the automatic lighter is worth the slight additional operating cost.

The best oven is well insulated, has interior dimensions of about 16 inches wide, 14 inches high, and 19 inches deep, with adequate rack space and is equipped with an accurate automatic heat control so that it is possible to maintain a temperature of 250° F. for at least 3 hours. While the choice of the model depends upon the individual's taste and the arrangement of the kitchen, the interested housewife is reminded that the biggest advantage of the console model is that no stooping is required to put food in and remove it from the oven. In the table-top model the oven is located below the cooking surface. The Nebraska Station has found that in the majority of cases the higher priced ranges have much heavier sheet enamel and are, therefore, somewhat sturdier than the cheaper ranges.

When there is a choice between electricity and gas for cooking, there are many points to be considered in addition to the obvious one of the relative expense of the two fuels in any particular locality. A comparative study on electric- and gas-range ovens conducted at the Indiana Station reveals that the electric ovens require less time for preheating and more energy than do the gas ovens and they also show better heat retention. In other words, cooking continues longer after the heat is turned off in the electric ovens than in the gas ovens. Although both gave satisfactory results, the gas ovens maintained a more even temperature during long heating periods. That it represents economy to use the oven for more than one product when it is heated is established by this study, which shows that in baking periods of less than 1 hour the cost to preheat an electric oven is generally greater than the actual baking cost.

Approaching the same question from a different angle, investigators at the Iowa Station have determined the desirability of baking

some food products by starting them in cold and in preheated ovens. They baked plain and angel food cakes, baking-powder biscuits, yeast rolls, and cream puffs by both methods, using ovens in two gas, one kerosene, and three electric ranges. The cakes baked in the preheated ovens scored considerably higher than those started in the cold ovens. Baking-powder biscuits baked in preheated electric ovens were preferred by the judges, but in the gas and kerosene ovens the products were equally desirable regardless of the method of baking or the type of range. The cream puffs baked equally successfully from a cold and a preheated start. The differences in fuel consumption in the two methods of baking were considered practically negligible, as were the differences in time required in the gas and kerosene ranges. However, there was a saving of time when the foods were baked in the preheated ovens of the electric ranges.

In many a rural home to which electric power has been made available through the development of power lines, there is little left for the purchase of desired equipment after the electrical installation and wiring have been paid for. With this in mind, the Virginia Station, with the cooperation of the Tennessee Valley Authority, has investigated the possibilities of developing low-cost electric cooking equipment. Complete tests were first made of inexpensive electric hot plates found on the market, with the conclusion that they are far from durable. None of the stoves lasted as long as 200 hours, although one burner of a two-burner stove was still usable when the tests were stopped. There was little to complain of in the structure of the stove or the units, most of the failures being due to the switches and wiring. In view of the low cost of these hot plates, which ranged from 98 cents to \$4.95 in price, it was felt that the duration of service might be all that could be expected, but that there would be little satisfaction in buying a cheap stove of this kind except for some special and temporary use.

Turning their attention next to the manufacture of durable and serviceable electric stoves, the Virginia Station investigators found that very satisfactory models of the hot-plate type could be made at a cost of about \$4.50 for the two-burner size and about \$6 for the three-burner size if materials alone were considered. The station has prepared working specifications (B. 310) for the construction of such a stove of the hot-plate type, and also of a complete electric range. Construction of the latter is not recommended, however, unless there is available a shop with complete manufacturing facilities.

A unique feature of these electric stoves is the abandonment of the rather expensive rotary three-heat switch. Very satisfactory results were obtained by dividing the burner element into two parts of different wattage and wiring to each a single pole toggle switch. This method was also followed in electrifying old kerosene stoves and even cheap-type kerosene ovens.

An old kerosene stove stripped of its burners and excess parts and then supplied with electric units and switches is apparently the best low-cost electric stove available. It has advantages with respect to height, quick assembly, and appearance over the hot-plate type of stove and costs no more.

The cost of the material for such a reconstruction, allowing \$1 for the cost of an old kerosene stove, is estimated at \$7.20. After the old stove has been made ready for wiring, only about one-half day of a mechanic's time is required to electrify it. Similarly, the

cost of materials for an electrified oven is estimated at \$4.75 if \$1.95 is allowed for a new oven of the kerosene-stove type.

The method of installing variable wattage elements in an oven is thought to have considerable merit in the uniformity of temperature which can be maintained. In the cheaper ovens the most efficient use of the electric current was not attained, but experiments with the better grade of commercial ovens indicate that the energy consumption will compare very favorably with the present method of thermostat temperature control.

Cooking utensils.—In further study at the Iowa Station of the relative efficiency of different utensils for surface cooking, considerable information was obtained on the efficiency of different types of surface units in the electric range as determined by the temperature distribution over the under surface of cooking utensils and the length of time required to bring a given amount of water to boil and to complete certain short-time and long-time cooking processes. The distribution of temperature over the surface of an electric unit was found to be fairly uniform with a slightly lower temperature at the outer edge. Both from a cold start and when preheated the enclosed unit required the least time, the open, embedded, and enclosed labyrinths slightly longer, and the cone-reflector type considerably longer time. It will be remembered that in the gas range the enclosed unit was also more efficient than the open. As for the utensils, which were made exactly alike—2-quart capacity, medium-weight, straight sides, flat bottom, and tight-fitting lids of copper, aluminum, and enamelware, all were practically equal in efficiency. A black-bottom finish tended to increase to a very slight degree the cooking efficiency of the aluminum pans, but did not increase the efficiency of the enamelware utensils.

Further guides for the purchase of surface-burner utensils for electric ranges are given in the technical report of the investigations at the Maine Station noted in the 1936 report on the stations. Black bottoms on aluminum or other polished metal pans were found to reduce time and cost of heating and boiling when used on cone, open, and tubular units, but if electricity is relatively cheap and the utensils have a rough-bottom finish, the extra cost of the black-bottom utensils is not warranted except in the case of the cone unit. With closed and ring units a black bottom in a utensil does not reduce appreciably the cost and time of heating. The value of a cover in reducing water losses depends upon the amount of heat being applied. A cover may be essential if medium or low wattage is used and is most essential for a wide pan even when it is used on the high heat of a 1,000-watt unit. A triplicate set of saucepans small enough in diameter to use on a small unit is more economical than single pans on three such units, but one so wide that a larger high-wattage unit must be employed may be no more economical than carefully controlled cooking in single pans. A pressure cooker or a well-built large saucepan may be used in place of a "waterless" cooker.

In a study at Kansas State College of the effect of the material of the pan on the temperature for baking and tenderness of angel food cake it was found that the cakes baked at the same oven temperature for the same length of time in enamel and glass pans showed a greater rise of temperature within the cake than those baked in aluminum and tin pans and had a much browner crust. The cakes baked in the enamel pans were also much tougher. This means that a somewhat lower oven

temperature and shorter time of baking should be used for cakes baked in enamel or glass pans than in tin or aluminum. This is probably a good general rule to follow in baking.

Vacuum cleaners.—One point which has been given comparatively little attention in the selection of a vacuum cleaner from the two main types of suction and suction with motor-driven brush is whether or not different types of rugs are cleaned more efficiently by cleaners working on different principles. A study at the Washington Station of nine vacuum cleaners operated on rugs of three types—axminster, wilton, and velvet—showed that the three types of rugs are very similar in their cleaning characteristics, but the cleaners using suction with motor-driven brush removed approximately one-third more dirt in a given time than those using straight suction. The amount of nap removed with the dirt varied with the individual cleaners and type of rug, but the wearing action as thus measured was considered to be very minor as compared with the wear of normal use. All but one of the slower cleaners tested cost less than \$50, while the faster ones ranged from \$50 to \$80. The price alone should not be accepted as an indication of the efficiency and durability of the machine, but if the housekeeper's time is a factor to be considered, the additional cost of an efficient machine of the faster cleaning type is worth considering. After a vacuum cleaner of any type has been purchased and put into use, the cleanliness of the inner surface of the bag is one of the most important factors to consider. In tests made in homes the Washington investigator found good cleaners giving very poor service simply because the bags were not thoroughly cleaned after use.

Electric irons.—The electric iron is one of the first appliances purchased when electricity becomes available in the rural home. So many improvements in design, durability, and efficiency have been made in new models that in homes where models of 10 or more years ago are still in service it may be economy to discard them and make a selection from among the many models now on the market. To help the housewife in the selection of an electric iron, whether it be the first or a replacement, the Virginia Station conducted a series of tests on about 20 well-known makes and models of electric irons now on the market. The report of these studies (B. 307) is a useful guide for the purchase of an electric iron.

In the advice given by the Virginia Station, it is stated at the outset that "to get an iron of long-time usefulness and dependability the price that will have to be paid will range between \$5 and \$9. Cheaper irons than this are not likely to give entire satisfaction." The new lightweight irons are entirely satisfactory, although 3 pounds is about the minimum weight for durability. In most cases low wattage (550-660) irons do not produce satisfactory ironing temperature. A 1,000-watt iron is recommended as best for regular and continued household use. The iron should be provided with thermostatic control, preferably marked with names of the material for which specific temperatures are suitable instead of high, medium, and low, and with an "off-setting" to serve as a switch. A permanently attached cord eliminates connection trouble particularly if the "off" is used as switch and the cord disconnected at the wall receptacle when not in use. Other features to be considered are some device for keeping a hot iron from scorching the board when tem-

porarily out of use, a well-insulated, well-shaped handle, beveled edge and sharp-pointed front, and a good appearance. As an indirect aid to the purchaser, the bulletin contains suggested standard specifications for electric irons which, if adopted by the manufacturer and indicated on the iron by a distinctive emblem, would serve as an indication and guarantee of first-grade quality and performance.

WORK CENTERS AND WORKING SURFACE HEIGHTS

Even with the best selection of household equipment the work which is done with it may be rendered inefficient by poor arrangement and placing. In a few of the experiment stations some work is being done on this rather neglected phase of research on problems related to the home.

Kitchen arrangement.—The results of a survey made by the Indiana Station of nearly 800 rural kitchens in the State showed that they vary in size from 6 by 7 feet to 24 by 24 feet, and that many are inefficiently arranged and inadequately equipped. Feeling that, "since farm homemakers spend an average of 54 hours a week in homemaking activities, the kitchen should receive more thought and attention when planning the home than any other room," the Indiana investigators selected a floor space 12 by 15 feet long as typical of the majority of Indiana rural kitchens and studied various ways of arranging in the space the equipment found in most kitchens. Each arrangement was tested by carrying out several typical tasks and noticing the number of steps involved. Some of the suggestions made as a result of this study could probably be followed to advantage by many a housewife in rearranging her kitchen. In a well-equipped and well-arranged kitchen the housewife should be able to start at the storage center and carry through the meal preparations to the final serving in the dining room with little retracing of steps or crossing from one work space to another. In a long narrow kitchen the equipment should be arranged around the end of the room, while in a square kitchen an L-shaped arrangement is more efficient. Sufficient light should be available at all work centers.

Standards for working-surface heights.—The saving of steps is one way of reducing fatigue in household tasks; another is to have all working surfaces at the correct height for the individual housewife. In order to supply some of the information required for setting up standards for working-surface heights which will meet the requirements of the average woman, investigators at the Oregon and Washington Stations recorded certain body measurements and preferred surface heights for various household activities of 312 Oregon and 250 Washington women, most of whom had homemaking as a full-time occupation. As judged from the data obtained, the average homemaker prefers a sink set so that its floor is 32½ inches above the floor of the room, a work table for mixing or beating 32 inches, an ironing board 32½ inches, a serving table 24 inches, and a cutting table 35½ inches above the floor. The variations of individual preferences from these average heights were surprisingly small. Two-thirds of the women tested chose work-table heights between 32 and 33 inches, beating heights between 30 and 33 inches, and dishwashing and ironing heights between 31 and 34 inches. Preferences as to cutting heights varied to a greater extent, but more than half of those making the test chose heights between 34 and 37 inches.

The differences in preferred heights for various tasks are explained from the different postures required. The fact that the majority of women, although varying considerably in height, were satisfied with the average heights, was explained through the discovery that although the range in total heights was more than 16 inches, there was a much narrower range in distance from the hands to the floor. The women selecting working heights fairly close to averages had wrist heights within plus or minus 1 inch of the preferred levels. When the working-surface heights selected by trial as most comfortable were compared with the actual heights of the same surfaces in the homes of the women taking part in the study, it was found that the differences were most marked in the heights of the sink and the cutting table. The average woman chose a sink 3.5 inches higher than that of her sink at home and a cutting table about 5 inches higher than the dining table which is often used for cutting. The home equipment was more often too low than too high for rolling pastry and too high rather than too low for beating.

The body measurements, which were a part of this study, were taken to determine average values for dimensions, based on eye level, standing and sitting, and for sitting arrangements for various tasks. In publications from the two stations (Oreg. B. 348 and Wash. B. 345), which give the complete report of this study, the average dimensions of various space units and equipment have been tabulated and form a useful construction guide.

QUALITY IN FAMILY LIVING

The proper selection and use of all available material resources, such as have been discussed in the previous sections on quality in foods, textiles, and equipment, play an important part in determining the quality of family living. This requires wise management by the farm housewife of the resources of the farm in cash income and goods and oftentimes the supplementing of the all too small cash income by enterprises of her own. Other equally important factors may be grouped under the general heading of family relationships, the intangible factors which make or mar family living. The experiment stations are investigating both the tangible and intangible factors which affect the quality of family living.

Contribution of housewife to family income.—The contributions which the farm housewife may make to the family income are generally considered simply as the cash which she may contribute to the family purse through the sale of farm products, unless she is engaged in some enterprise unassociated with the farm. In a study at the Oklahoma Station of the contributions to the family income during a single year by housewives on wheat, cotton, and diversified farms in the State, the contributions considered included not only the cash income from enterprises managed by the housewife, but also the money released when she contributed products for the family living which otherwise would have to be purchased, and the money released by her labor which otherwise would have to be hired. This does not include the ordinary homemaking and housekeeping activities, but the extra work quite outside the management of the home. For making the calculations where actual cash was not involved, the values of products used by the family were based on Oklahoma farm prices, and of labor at 15 cents per hour.

For the more than 150 housewives from whom records were obtained, the average net cash contribution to the family income was \$168, the calculated contribution to the income of home or farm producing goods \$54, and the contribution from labor saved \$69. While the first of these figures is probably the only one to afford any satisfaction to the housewife, and perhaps the rest of her family, the other two should be taken into consideration as being just as much of a contribution as actual cash sales. The largest single cash contribution made by a housewife on a diversified farm was \$1,258, on a wheat farm \$1,887, and on a cotton farm \$1,075. The dairy enterprise (butter and cream) was the one most commonly engaged in, followed by the poultry enterprise (stock, cockerels, broilers and fryers, and eggs), and then by the garden enterprise which, as would be expected, was much more profitable on diversified than on wheat farms and still more so than on cotton farms.

Numerous other enterprises were engaged in by various housewives, but most of these did not afford opportunities for large returns. Success in any enterprise, but particularly in the three involving farm products, depended largely upon the initiative, interest, and hard work of the woman.

The women who were most successful in any of the enterprises were those who were able to produce a well standardized product regardless of the effort necessary, and who supplied a steady output so that customers would not be disappointed. Regardless of all efforts, the woman had to be alert to her best market.

In rural communities close to urban centers, as is the case in Rhode Island, the housewife may have a part- or full-time job outside the home and yet attempt to be a homemaker. What effect does this have on the quality of living in the home? The Rhode Island Station has made a special study of the underlying causes and resulting conditions of such employment among over 600 rural women in one county of the State. Although satisfactory reports of cash income were secured from only about half of the cooperating women, they showed a weekly average of \$17.79, a sum which, if added to other sources of income of the family, could not help but raise the standard of living in the group and probably of the community.

While most women in the Rhode Island study gave more than one reason for working outside the home, approximately 85 percent listed necessity as the main reason and 33 percent worked to obtain luxuries such as electrical equipment and washing machines. To 7.7 percent it served as an outlet for surplus energy, 4.2 percent worked for financial independence, 1.8 percent to escape housework, and 10.4 percent to pay for the home, help relatives, educate children, or for other miscellaneous reasons. The following types of work were engaged in: Industrial, 33.6 percent of the group; domestic, 17.3; commercial, 17; professional, 13.6; boarding and lodging, 11.1; homecraft, 5.3; agricultural, 1; and miscellaneous, 1.1 percent.

A survey of the equipment in the homes showed that a large proportion had electricity and some were very completely supplied with modern equipment. About 60 percent of the income-earning homemakers bought at least three-fourths of the clothing for their families and about one-half bought all of the bread consumed, while about one-third sent out part or all of their laundry and nearly 9 out of every 10 women bought canned foods.

A few women felt that it was a hardship to have to carry on income-producing work in addition to that of the home, and a few others reported that their husbands did not like to have them do so. In most cases, however, both the worker and the family seemed not only willing but anxious that her work should continue.

Planned spending for better family living.—Family account books kept year after year are exceedingly valuable, not only to the individual families keeping them, but also to all who are interested in the changes in spending habits which follow changes in income. As noted in previous reports, account keeping has become a habit among Illinois farm and village families largely as a result of the continued efforts of the experiment station workers to help the individual families view their own situation and evaluate their spending and saving habits in comparison with the general trends as shown by careful analysis of each year's records.

For the year 1935-36, 278 home-account records sufficiently complete to summarize were received at the station. Of these, 216 were from farm families and 62 from town families. In comparison with the figures for the 231 farm-family records studied the previous year, there was nearly 16 percent more realized income and 20 percent more cash available for family use. How was this increase spent? It was used for increasing life insurance payments and decreasing indebtedness, for buying more fresh fruits and certain luxury food items, for repairs and upkeep of the house, for the replacement of furnishings and the purchase of new furniture and equipment, for new clothing, particularly for the housewife who had to practice rigid self-denial during the depression, for new or later model cars, and finally for increase in health and recreation expenditures. "It would appear that choices in spending are being weighed in terms of satisfactions in living for the family." The greatest value of these Illinois home-account records, kept year after year, is the opportunity they afford for long-time planning, based upon the adjustments which have been necessary with the inevitable shifts in family income.

Occupations of farm-reared youth.—The complex factors involved in family living undoubtedly play an important part in determining the future of the young people in the family. There are some who go so far as to say that the physical equipment of the home is a significant factor in determining how long the children will remain in the home. In a limited study at the Connecticut (Storrs) Station of the relation of the equipment of rural homes for the promotion of convenience, comfort, and health to the proportion of sons and daughters 16 years of age and older continuing to live at home, the conclusion is drawn that—

if young people, and young women in particular, are to prolong their residence in their paternal homes, the equipment of these homes as to convenience, comfort, and health must measure up well with the better current standards of domestic life in this country.

For most rural homes, however, it is even more important to determine the factors responsible for the type of occupation which the sons and some of the daughters will follow. In farming, as in any other occupation, the son may not always wish to follow in the footsteps of his father. Is it as easy for the son in rural families to select an occupation to his liking as in urban families? In a recently completed investigation by the Mississippi Station of the occupations of sons and daughters of Mississippi cotton farmers, three-fourths of the

more than 1,500 sons and daughters 19 to 34 years of age were farmers, or were dependent at least in part upon the farm for livelihood. An attempt to determine the factors responsible for this situation led to the conclusion that the principal factor was that the majority lived where opportunities for engaging in any kind of work except farming were limited. Many of the group studied were still too young, 19 to 23 years of age, to have become permanently established. Many of the families were tenants with little opportunity afforded the younger people for entering nonfarm work. The limited schooling of most of the young people was another factor preventing them from seeking other occupations.

Looking into the future, the Mississippi investigator pictured the desirable occupational situation for this group of cotton farmers' sons and daughters as—

a situation in which each of them had the opportunity and training to engage in the occupation best suited to his ability. There are three methods, it is believed, of bringing about such a situation: (1) Public provision of more educational facilities than in the past; (2) greater public supervision of health and control of sanitation; (3) an increase in the general level of incomes. * * *

The vocational situation of rural young folk is a vital family problem, but its solution lies largely in the hands of the State. Upon the family, however, rests some of the responsibility for training and most of the responsibility for exposing their children to situations where they will have more occupational opportunities. There are latent in every community opportunities for the development of abilities and vocations of sons and daughters. It is the responsibility of the family to seek these out, to improve them, or to move them elsewhere if need be.

Family relationships.—In times past much more attention has been paid in experiment station research on home problems to the tangible than the intangible factors affecting family life. However, a growing interest is being shown in personality and family relationships. These factors are given some consideration in the Mississippi study noted above, and even more in two investigations at other stations which are under way. One of these, at the Nebraska Station, is a comparative study of young people from farm, village, and city homes in regard to possible relationships between character and personality adjustment and home and family influences. The other, which was started toward the close of the year at the Virginia Station, deals with the interests, problems, and activities of white rural home-makers in a certain district in the State. These two projects should make a valuable contribution to the quality of living in rural homes.

SYBIL L. SMITH.



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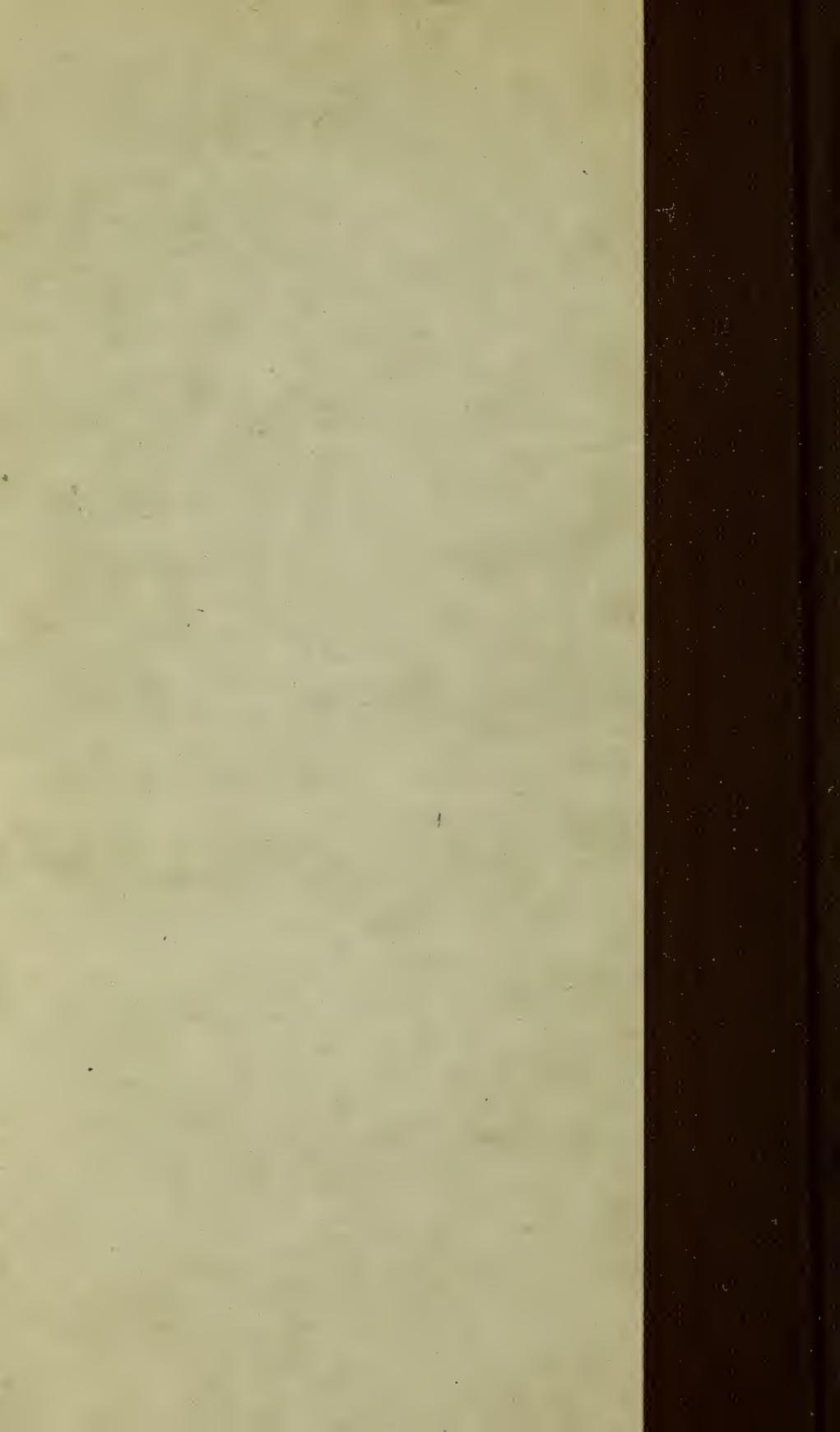
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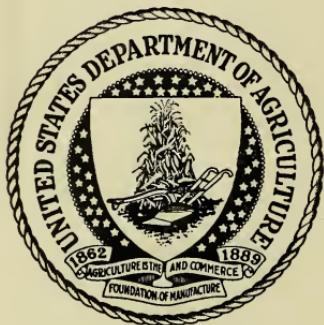
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FOODS AND NUTRITION, EQUIPMENT, AND ECONOMICS OF THE HOUSEHOLD

Reprint of pages 145-159 from Report on the Agricultural Experiment Stations, 1938

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UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1939

FOODS AND NUTRITION, EQUIPMENT, AND ECONOMICS OF THE HOUSEHOLD

By MABEL A. DICKSON, *Associate Home Economist*

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"Better Eating, Better Health, and Better Living" might well be the slogan of the experiment stations where research studies are being carried on which deal with the rural family's food and the nutrition of the members of the family, the house and its equipment, and the standards of living of the family. The few examples noted below have been selected to illustrate the progress made during the past year.

FOODS AND NUTRITION

The specialists in food research have been engaged during the year in many different types of work, ranging from the analytical studies on the chemical nature of the food constituents to the routine cooking tests that are such an important part of any study in which the quality of food products is under investigation. The development of improved methods of preserving and storing foods, and preparing them for the table represents the major part of the studies in progress or just completed in the field of food research. In a few experiment stations progress has been made in finding new uses for some agricultural products. In nutrition research the progress made by the groups participating in the regional cooperative projects on nutritional status of young women, which were reviewed in the 1937 report, is sufficient proof that by such concerted effort a great deal more can be accomplished than by working separately in applying to large groups of the population the results of laboratory and clinical research in nutrition. Research investigations with animals as experimental subjects have revealed the effects, such as rickets, pellagra, anemia, and scurvy, of specific dietary deficiencies. The dietary studies have shown that many groups are inadequately fed. The present trend is toward more fundamental research in human nutrition by studying the relationships between diet and creative effort, between diet and health and vitality, and between deficiencies of agricultural production, wealth, and human welfare.

FOODS

Food preservation by freezing.—With the advent of the storage-locker plant in many rural communities, and more recently of the refrigerator containing a separate storage section for frozen foods, a number of experiment stations have been studying methods of freezing, storing, and cooking frozen-pack foods. The New York State Station has worked out simple methods for the preparation and freezing of fruits and vegetables intended for storage in lockers. In view of the fact that the spores of bacteria and fungi as well as the growing micro-organisms are not all killed either by hot blanching or by freezing, the wise homemaker is unusually careful in preparing home-grown foods for preservation by freezing. The precautions noted by the New York State Station include a consideration of variety, maturity, and freshness in selecting the vegetables and fruits, and, if they cannot be prepared for freezing immediately after harvest, in keeping them in a cellar, ice house, or some other cool place. Frozen fruits are mostly eaten raw for dessert and therefore cannot be subjected to heat before freezing to inactivate the enzymes as is done with vegetables. The addition of sugar or sugar sirup is the method used to slow up enzyme action and deterioration, but since some time is required for the sugar to penetrate the fruit the quick-freezing method used for vegetables offers little advantage for fruits. The station recommends packing the fruit with sugar in small containers and placing it in cold storage maintained at 0° F. or below, with a free circulation of air. Peas, lima beans, spinach, asparagus, sweet corn, snap beans, strawberries, sour cherries, currants, cranberries, blueberries, and peaches may be successfully frozen for locker storage using the methods advised by this station.

At the Washington Station a study in cooperation with the Department of Agriculture (B.C.&S.) was begun in 1936 to determine the adaptability of different varieties of vegetables to freezing preservation and, to date, the specialists in food preparation have made cooking tests on almost 300 varieties of frozen-pack vegetables. While no fine distinctions relative to quality factors can be drawn from the limited data now available, the general results confirm previous findings that selected varieties of peas, bush and pole snap beans, and early-maturing sweet corn are well adapted to freezing preservation. For example, of 82 varieties of peas packed by the frozen method and tested by cooking in boiling water for 7 minutes, about 35 are classified as "well adapted," "promising," or "worth further trial," and 9 are already being frozen commercially with excellent results. Of 26 varieties of snap beans, 24 were found to be well adapted to freezing preservation.

Food preservation by canning.—One of the most important food problems—the effect of the canning process on its nutritive value—continues to be an interesting research study. According to investigations carried on at the Massachusetts Station, canning destroys from 50 to 85 percent of the vitamin C content of peas, lima beans, spinach, and green asparagus as compared with about 30 percent lost during the commercial freezing process.

Apparently the acid in tomatoes protects them from loss of vitamin C during canning, as well as during storage, shipping, and market-

ing. The same varieties of the 1936 crop of tomatoes which the Massachusetts Station reported to be good sources of vitamin C were also high in 1937 when compared with other varieties, but all contained from 20 to 30 percent less of the vitamin, indicating that seasonal as well as varietal differences may greatly alter the vitamin C content of commercial and home-canned tomato products. Partly ripe tomatoes contained as much vitamin C as did freshly picked or stored ripe tomatoes. The Massachusetts Station also found no significant loss in vitamin C in tomatoes canned either in glass or in tin when stored for about 4 months in reduced light at room temperature. The Florida Station found that home-canned tomatoes and tomato juice preserved according to the directions given out through the extension home demonstration agents contained as much vitamin C as five different commercial brands.

Tomato juice canned in glass bottles and in tin cans in a commercial plant lost about 10 percent of its original vitamin C content during processing and an additional 10 percent during 40 days' storage, with no further loss occurring during the remaining 190 days of the storage period. The explanation given by the New York State Station workers who made the tests is that since the juice was not deaerated it contained some dissolved and entrapped air that caused some loss of vitamin C during the processing and a further loss during the first few weeks of storage. During this period the oxygen was entirely used up and therefore no loss of vitamin C occurred afterward. The greater the head space in the glass bottles the greater was the loss of vitamin C occurring in the juice during cooling and storage. No appreciable difference was noted in the vitamin C content of the completely filled glass bottles and tin cans at any time during the storage period. The evidence presented suggests that vitamin C is not lost more rapidly from tomato juice packed in bottles filled completely than from tomato juice in tin cans similarly filled, but the loss is considerable if the bottles are only partially filled.

Food storage.—Storage problems of foods that have not been preserved by freezing or by canning have also received attention. For lengthening the cucumber season the Texas Station recommends wrapping the ripe cucumbers individually in moistureproof cellophane or packing them unwrapped in a basket or crate lined with the cellophane and storing them in an electric refrigerator at a temperature between 35° and 40° F. According to the score cards of the panel of judges, the cucumbers remained for 8 days practically as desirable as when freshly harvested, and for a period of 2 weeks were acceptable although not in choice condition.

The best storage conditions to retard the staling of bread are a temperature close to 42° F., with the bread wrapped and sealed in wax paper at the end of a 1-hour cooling period after removal from the oven. When this procedure was followed at the Minnesota Station the bread remained quite fresh for a period of about 4 days. The most rapid staling took place during the first 8 to 12 hours after the loaves were removed from the oven. It is of interest to note that the addition of soybean flour to the bread dough delayed the staling process for an additional 24 hours. Also, the bread made from semi-hard-wheat flour staled less rapidly than did bread made from soft-

wheat flour, indicating that protein characteristics may be one of the factors involved in the staling process.

Food preparation.—In the preparation of foods for the table the best methods are those that ensure the greatest retention of flavor, color, and palatability as well as nutritive value. With the output of vegetables preserved by the frozen-pack method on the Pacific coast increasing from about 12,000,000 pounds in 1936 to 20,000,000 pounds in 1937, the Oregon and Washington Stations are studying the best methods of preparing frozen vegetables for the table. So far as the vitamin C content is concerned, the Oregon workers recommend cooking frozen-pack peas in the top part of a double boiler. When the peas are thawed at room temperature before cooking, more of the vitamin C content is lost. The greatest losses were found to be due to the solubility of the vitamin C in the cooking water, with the length of the cooking time, the temperature at which the peas were cooked, and the length of time they were allowed to stand before cooking all exerting some influence. A panel of judges at the Washington Station preferred the quality, without considering the nutritive value, of frozen-pack peas cooked by steaming rather than those cooked in water or in a pressure cooker.

Steaming is also recommended for frozen-pack spinach by the Massachusetts Station, after it was found that the steamed spinach had retained about twice as much vitamin C as boiled spinach.

The New York State Station found that when cooking cut or shredded cabbage a great deal of the vitamin C content is dissolved in the cooking water. The first few minutes of cooking are the hardest on the vitamin, about one-fourth of it being lost then. After that, the loss is relatively small. Cabbage that is cooked by steaming contains more vitamin C than drained, boiled cabbage. In panfried cabbage, which is prepared by heating finely shredded raw cabbage with a little butter or other fat, the vitamin C retained amounts to about two-thirds of the original content, which is higher than for either steamed or boiled cabbage. The most common way of cooking cabbage—shredding, boiling in water, and then draining off the water—is the most wasteful as far as the vitamin C content is concerned. A good deal of the vitamin goes off in the water and more is destroyed by contact with the air and heat in boiling.

When apples are baked in a covered or uncovered casserole or in a pie they lose about 80 percent of their vitamin C content and if allowed to stand at room temperature for 48 hours after being removed from the oven, another 8 percent will be lost. Apples made into sauce lose about 25 percent of their vitamin C content if the unstrained sauce is made from peeled apples, and over 30 percent if unpeeled apples are used and the sauce is strained. In the applesauce made from peeled apples the greatest loss takes place during the first 4 minutes of cooking. The New York State Station, where the tests were made, found that the factors that influence the loss of vitamin C from apples are the length of the cooking period, the relatively slow rate of heat penetration with a corresponding delayed effect on the oxidizing enzymes, and the presence of air.

To supply 15 milligrams of ascorbic acid, the Washington Station has calculated that it would require about one and one-half to two average-size fresh whole Esopus (Spitzenberg) apples, two Rome

Beauty, two to two and one-half Winesap or Yellow Newtown, two to three Golden Delicious, four to five Delicious, five Richared, or six Jonathan apples.

In tests made at the New Mexico Station the vitamin B₁ content of pinto beans was retained to the greatest extent when the beans were soaked for 16 hours, parboiled for 15 minutes, and then cooked in soft water for 45 minutes at a temperature of 239° F. in a pressure cooker. The greatest loss of the vitamin occurred when the beans were soaked in water containing sodium bicarbonate and cooked by the same method, using tap water.

To improve the present methods of broiling beefsteaks the Missouri Station has an experienced panel of judges scoring steaks broiled at constant temperatures of 175° and 225° C. to an internal temperature of 58°. Mechanical determinations of tenderness are also being made. The steaks broiled at the higher temperature showed greater cooking losses, required less time but more fuel to cook, and had a greater loss in weight after removal from the oven, as well as giving a smaller percentage of edible material than did the steaks broiled at the lower temperature. The latter rated higher in palatability, with the exception of flavor and tenderness of the large muscle. After the steaks were removed from the oven the internal temperature of those cooked at the higher temperature continued to rise to about 64°, as compared to a final internal temperature of approximately 61° in the steaks broiled at the lower temperature. This continuation of the cooking process after the steaks are removed from the broiler should be taken into account when broiling steaks to the rare or medium stages.

In a comparison of club, porterhouse, and pinbone sirloin steaks, the first showed the greatest cooking losses, required the longest cooking time (almost 23 minutes per pound when cooked at the lower temperature and 20 minutes when cooked at the higher temperature) and showed the greatest rise in internal temperature after removal from the oven. The porterhouse steaks contained the largest percentage of edible meat and required 16 and 13 minutes cooking time, respectively, at the two broiler temperatures, while the pinbone sirloin steaks had the least cooking losses, required only 15 and 11 minutes cooking time, respectively, and showed the least rise in internal temperature after removal from the oven.

The Missouri Station also found that rib and loin pork chops braised without any water required only about 15 minutes cooking time, showed less cooking losses, and were more tender than when water was added. Pork chops broiled at either 150° or 175° C. had much greater cooking losses, required a much longer time to cook, and graded lower in palatability than did the pork chops braised either with or without added water. The pork chops braised without added water graded highest in the palatability factors of intensity and desirability of aroma, in texture, intensity, and desirability of flavor of lean; in tenderness of the large muscle; and in quantity and quality of juice.

While unskewered round-bone chuck roasts required almost 5 hours longer cooking time to reach the well-done stage, the Texas Station found them to be more tender even though the oven temperature was the same for the skewered and unskewered roasts.

Similar results were obtained with unskewered rib roasts which required an increased cooking time of about 2 hours over the skewered roasts. Evidently the use of metal skewers to shorten the time of cooking may be looked upon as a procedure of doubtful value where tenderness of the roast is an important factor.

New uses of agricultural products.—Scientists at various experiment stations are improving the methods of preparing and preserving fruit juices and creating new uses for these and other agricultural products. The new milk drinks that have been developed at the Illinois Station include chocolate-fudge milk, a honey-milk drink, and various fruit-milk drinks such as raspberry, grape, blackberry, pineapple, and cherry. Various cream spreads have also been developed, including fruit-flavored creams as well as cheese spreads. The development of such products is expected to expand the use of dairy products for home consumption, as well as add variety to the diet.

The Oregon Station has been developing new uses of prunes by creating new products from prune pulp and juice, and has prepared partly dried prunes for canning and dried prune halves for small packaging.

Native and imported mango varieties that lend themselves to canning, especially in the form of slices and as a juice nectar, are being investigated at the experiment station of the University of Puerto Rico. Also, an especially attractive nectar has been prepared from a red-fleshed papaya (*Carica papaya*), and the fruit has been found particularly well adapted to canning. These and other studies now in progress with citrus fruits and with grapes are of importance to the island, not alone for the possible commercial value of a large-scale canning industry but for the contribution in nutritive elements to the diet of Puerto Ricans.

The New York State Station has extended the fruit-juice studies to include rhubarb, cherry, peach, and various berry juices in addition to the common grape and apple juices. The flash-pasteurization method of preservation has been successfully applied to the home preparation of apple juice on a small scale. The procedure is simple, consisting merely of the passage of the juice, with or without clarification, and deaeration through a heated coil of tubing. The hot juice is packed in enamel-lined cans or in bottles, which are immediately closed and inverted or turned on their side for 3 minutes and then quickly cooled. This method of preservation represents a definite improvement over older methods, for the aroma, flavor, and appearance of the juice are not modified to any material degree even after storage for 1 year at room temperature.

The New York State Station has also improved the old methods of making and preserving grape juice in the home. The jars of pasteurized juice should be placed in a cool cellar for from 3 to 6 months to allow crystallization and settling out of the crude cream of tartar. Then the juice is filtered, rebottled, and repasteurized unless it is to be used immediately, or it may be kept a few days in a refrigerator without spoilage. The bottled grape juice may be used in preparing jellies by adding one of the liquid or powdered pectin preparations, according to the usual jelly-making procedure.

While a somewhat similar procedure may be followed for the preparation of cherry juice, the method has not yet been adapted for use on the average farm without special equipment.

NUTRITION

Although there is a very noticeable trend toward more research in human nutrition using human beings as subjects, the use of laboratory animals for the solution of many human-nutrition problems continues to make up a large part of the research program in this field.

The following examples of studies now in progress at a number of experiment stations give an indication of the complexity of the problems of nutrition and serve to illustrate some of the interrelationships existing among the different constituents of food. The Wisconsin Station has demonstrated that the nutritional disorder produced in rats and chicks by high egg-white intakes can be relieved or prevented by thorough cooking of the egg white or by the addition of egg yolk in amounts equaling 5 to 10 times the content of egg white in the ration. The protective factor occurs in a fairly high concentration in turkey and chick liver, to a less extent in pork, beef, and lamb kidney; pork, beef, and rabbit liver; canned trout liver; and horse adrenals, and in very small amounts in beef lung, spleen, and heart. Preliminary studies on the tissues of the rats receiving the high egg-white ration without the additional protective factor indicate that injury to the central nervous system occurs and in weanling rats a condition somewhat similar to adrenal insufficiency develops. However, the administration of a potent commercial extract of adrenal cortex does not relieve or prevent the symptoms.

The California Station has been studying the production of cataract in the eyes of rats receiving vitamin B₂-deficient diets containing either lactose or cornstarch. The results indicate that lactose favors the production in the intestine of flavine and vitamin B₆, and cornstarch either carries with it, or favors the production of, the filtrate factor. Since sucrose neither carries nor produces in the intestine any of the vitamin B-complex factors, it is recommended as the best carbohydrate for use in vitamin B₂-assay tests. It was noted, with considerable interest, that the hair of the filtrate-factor-deficient rats, particularly those on the sucrose diet, turned gray. Upon the addition of the filtrate factor the normal color returned rapidly.

Also in studies on rats, the Illinois Station has determined the relative effects of different carbohydrates and of vitamin D on mineral metabolism. The rats that were kept on the lactose ration had greater retentions of calcium, phosphorus, and magnesium than did those on the starch and sucrose diets. The greater retention on the lactose and also on cod-liver-oil rations is attributed to the decreased excretion of the minerals by way of the intestine. While the lactose, sucrose, and galactose did not exhibit any growth-promoting value superior to that of starch, the lactose did cause an acceleration in the calcification of the bone. It is of interest here to note that the Wisconsin Station has found that the content of butterfat in the milk is a determining factor in the utilization of the milk sugar by the rat.

The Wisconsin Station has been testing protein as a limiting factor in the formation of hemoglobin in nutritionally anemic rats receiving sufficient amounts of iron and copper to permit optimal response. So far as the rat is concerned, the proteins of liver, casein, egg white, and soybean meal are consistently effective in building hemoglobin, whereas corn-gluten meal, wheat gluten, gliadin, and gelatin are poorly utilized. Evidently those proteins that permit good growth will also allow optimum hemoglobin regeneration.

As an example of the many studies now in progress in a number of experiment stations in which the nutritive value of various foods is being determined by bioassays in rats, the Hawaii Station has found that the cowpea (*Vigna sinensis*) is a good source of vitamins A and B₁, and that bitter squash (*Momordica charantia*) leaves and shoots are excellent and the fruit a fair source of these vitamins. Of other vegetables commonly used by Filipinos, the sweetpotato (*Ipomoea batatas*) is an excellent source of vitamin A and a good source of vitamin B₁ and cooked shelled pigeonpea (*Cajanus cajan*) is good for both vitamins, while the horseradish tree (*Moringa oleifera*) is an excellent source. A diet high in poi is not apt to be lacking in vitamin B₁, since the content of that vitamin in taro flour is almost 1 International Unit per gram, or about 25 units per 100 calories, according to tests made at the Hawaii Station.

To the long list of discoveries whereby man's diseases have been brought under better control through tests conducted on animals may now be added the discovery made at the Wisconsin Station that the nicotinic acid amide isolated from liver is the antipellagra vitamin. When the test material was fed to dogs afflicted with the blacktongue disease it was found that an almost microscopic dose of 30 milligrams was sufficient to cure them. Work at the California Station and in other laboratories has shown that blacktongue in dogs is caused by the same dietary deficiency producing pellagra in man. Just why nicotinic acid is needed by the body is not yet definitely known, but the investigators at the Wisconsin Station advance the theory that it is present in one of the enzymes that transfer oxygen from the blood to the cells of the body, and therefore probably is essential for this purpose. It appears that the animal body cannot synthesize the vitamin from food components but must get it ready-made in the diet. The fact that liver contains the nicotinic acid amide is another point in favor of increased use of animal organs such as liver, kidney, brain, and heart, all of which are unusually rich in the vitamins that make up the B complex. The homemaker who buys only steaks and chops is missing a chance to get more nourishing foods at lower cost. Better nutrition would follow if modern folk would return to the meat-eating habits of the pioneers of this country who made use of virtually the whole carcass when they butchered an animal.

Human metabolism.—The Ohio Station, continuing studies on basal metabolism of human beings, has completed a series of tests on 11 college women, all of whom were apparently in good physical condition, although 4 were decidedly underweight in relation to age and height according to the Wood standards. For 1 week each subject weighed all the food taken and at each meal collected and weighed a sample equivalent to one-tenth the amount of the various foods selected. When the caloric value and protein content of these

samples were determined, it was found that the daily food intakes of the 11 girls ranged from 1,119 to 2,568 calories and contained from 41 to 82 grams of protein. The basal metabolism values ranged from 1,031 to 1,468 in total calories and from 31 to 37 in calories per square meter per hour.

Basal-metabolism tests were also made at the Ohio Station on 108 college women who are serving as subjects in the north-central regional cooperative project on the nutritional status of college women. For the group of 91 between the ages of 14 and 18 years, the average was 36.4 calories per square meter per hour as compared to 33.46 calories for the group of 17 girls within the age group of 17 to 22 years.

Using the same type of apparatus as was used at the Ohio Station, the Oklahoma Station made basal-metabolism tests on 84 children and 75 men. Expressed as calories per square meter of body surface per hour, the total heat production increased from 43.36 for 20 girls under 7 years of age to 52.1 for 6 girls aged from 12 to 15 years. Twelve boys under 7 years of age averaged 43.2 calories as compared to 63.45 calories for 6 boys aged from 12 to 14 years. The values obtained for the men were 41.03 calories for 27 between 17 and 19 years of age, 38.4 calories for 39 aged from 20 to 24 years, and 37.8 calories for 9 men between 25 and 30 years of age. The basal metabolism of the younger children was found to be in agreement with the northern standards of Du Bois, but fell below the normal with increasing age, the lowering being most marked with the age group of girls at puberty. The average basal metabolism of the men was 5.63 percent below the Du Bois standard.

The Nebraska Station, which is participating in the north-central regional cooperative project on the nutritional status of college women, has made balance studies on 27 college girls for periods of 5, 7, and 10 consecutive days. When the average daily intakes of protein, calcium, and phosphorus for the 5 weekdays were compared with those for Saturday and Sunday, an average difference of 22 percent was found. The difference between two consecutive 5-day periods, one of which consisted of 5 weekdays and the other 3 weekdays plus Saturday and Sunday, was nearly 15 percent. The findings suggest that a 7-day period made up of 5 weekdays plus Saturday and Sunday is necessary to secure representative food intake and subsequent metabolic picture for these college girls. A 10-day period appears to have no advantage over a 7-day period.

The Michigan Station has been studying the protein needs of children, using six preschool children receiving diets similar in all respects except for their protein content. While the protein content of the diet did not show much influence on the utilization of potassium, when the content was increased from 3 up to 4 grams per kilogram the retention of sodium and chlorine increased. During the period when they were receiving the higher protein diet all of the children showed more rapid weight gains, which are attributed to the tissue and fluid growth rather than to bone development.

Nutritional status of children.—The Maine Station, in cooperation with the State Department of Health, has been studying the food habits and nutritional status of children in selected communities in the State. They are not only collecting valuable data on the chil-

dren, but are finding out what improvement may be brought about in their health and nutritive condition as the result of health education in the schools and instruction of the mothers through various agencies. In a group of 250 children, bone defects from early rickets were frequently found, but there was very little evidence of vitamin A deficiency as determined by biophotometer tests. About one child in eight was 10 percent or more underweight in the fall examinations and about one in seven when the physical examinations were made the following spring. Except for an increased consumption of milk, the diets of the children had not improved markedly since the previous year.

The investigations of the South Carolina and Mississippi Stations, noted later in this report, reveal that many of the farm families studied were existing on diets low in calcium, iron, and several of the vitamins. Soils in some parts of the Southern States are known to be so deficient in iron that hogs raised on the forage grown there fail to grow and mature well. On the basis of such findings it has been suggested that the deficient soil is related to the occurrence of certain mild anemias so prevalent among the women of the South. The possibility of such a relationship is under investigation at the Florida Station. Hemoglobin values are being determined for groups of school children, and at the same time the predominant soil types for each district where the children live are being classified and mineral analyses made of the vegetables grown on these soils. In addition, dietary studies of representative families are being made. The evidence already accumulated indicates that the children whose food is grown on better soil have higher hemoglobin values. It would appear that the incidence of anemia among these Florida children is definitely related to the mineral, and particularly the iron content of the soil.

EQUIPMENT

It has long been realized that for nonacid foods the pressure-cooker method of canning is the safest. However, a recent survey in Nebraska indicated that considerable spoilage was occurring in foods canned by this method, and one of the causes seemed to be the inaccuracy of the pressure gages. As a result, a study was made by the Nebraska Station to determine the dependability of the pressure gage, the proper functioning of the safety valve, the methods of sealing the lid to the cooker, the evacuation of air from the cooker, and the use of a thermometer as the temperature indicator. From tests made on 12 new gages the possibility of constructing gages accurate within ± 0.5 pound per square inch was demonstrated. Using that figure as the limit of correct calibration, only 11 of 40 gages tested were found to be accurate under a pressure of 5 pounds and 7 under a pressure of 15 pounds. The safety valve in 6 of 11 cookers tested blew off satisfactorily at pressures between approximately 18 and 25 pounds, while the other 5 began to leak at pressures below the release pressures. In 8 of 10 new cookers leaks appeared around the safety valve at pressures of 18 and 20 pounds. The type of pressure cooker that has the cover clamped on by a band with one bolt was found to be the easiest to seal.

In choosing a pressure cooker the most important points to consider are the size and shape; the material from which it is made; the method of sealing and clamping; the type of pressure gage, safety valve, and petcock; and the possible use of a thermometer fitted into the cover. When the pressure cooker is used for canning nonacid foods the Nebraska Station recommends that the gage pressure be increased one-half pound per square inch for each additional 1,000 feet at altitudes above 1,000 feet. The temperatures indicated on the pressure gage should not be used as an indication of the processing temperature, since these temperatures are correct only for processing at sea level with an accurate gage. While the thermometer cannot replace the pressure gage the cooker may be equipped with a thermometer as well as a gage if it is desired to process in terms of temperature readings. The wise buyer of a new pressure cooker will have the pressure gage checked before purchasing the cooker and rechecked at the beginning of each canning season. In Nebraska the experiment station laboratory offers this service free to the citizens of the State. Some manufacturers of pressure cookers also advertise such service.

ECONOMICS OF THE FAMILY

During the past 10 years the Illinois Station has summarized the home account books of 1,044 families. Many of the families have kept continuous records since the year they started their first record. The farm-family home-account survey for 1937 was prepared from the home-account records received from 280 farm families living in 49 different counties located in all parts of the State.

The money value of living plus savings for these families was \$2,252, which is 7 percent higher than the \$2,113 for 240 farm families keeping home accounts in 1936. More cash was available for living, life-insurance payments, and the payment of principal and investments other than farm business in 1937 than in any year since 1929. When the amount of savings was deducted, the money value of living was \$1,826, of which \$618 was the value of the goods furnished by the farm for family use, and the remainder was met by cash expenditures. The value of the farm-furnished food was a little over one-fifth of the money value of living of the whole group.

Purchased food continues to be the most important item in the family's living. Not only was the money value of the food consumed over one-third of the entire money value, but on every income level the expenditure for food was the largest single cash outlay. Automobile purchase, maintenance, and operation ranked second, operating expenses third, and clothing expenditures fourth for the whole group on the average.

In recent years the Illinois Station has noticed a steadily growing interest in home modernization among the home-account keepers. Two of the goals most frequently mentioned by the farm homemakers have been home furnishings and equipment, and home improvements. Defining a modern home as one with a central heating plant, a lighting system, and running water under pressure, nearly one-third of the families lived in completely modern homes. Trends toward more comfortable living are evidenced by electrification and other im-

provements of farm homes and by purchases of household equipment to lighten the daily tasks. Such improvement in the way of living is the result of careful financial management on the part of the account-keeping families.

In order to obtain accurate information on relatively new houses, in which a contribution of home labor and native materials has been made, the Arkansas Station obtained records in 1937 on a group of 214 farmhouses, well distributed as to location, size, structural material, cash cost, and the annual income of the owners. The families studied had an average annual income of \$785 and an average cash expenditure for the house of \$740, with about one-third of the group spending less than \$250. About 70 percent of the houses were built without plans other than those prepared by the owner, 20 percent used some type of planning service, such as bulletins, booklets, periodicals, or plans furnished by the State College of Agriculture, and 10 percent obtained planning assistance from individuals. As might be expected, the planned houses averaged higher in cost, value, and convenience than the unplanned houses.

The four-room house size was the most common, and three-fourths of the houses had four, five, or six rooms. About 16 percent were classified as "crowded," that is, they contained less than one room per family member. In this group the family size was above average, a greater proportion of the value was contributed, and the annual income and expenditure for housing were below the general average. As the cash expenditures increased, the proportion of home labor used in the building decreased. The greatest proportions of home labor were contributed by families in the income groups under \$500. On the basis of cubic-foot unit costs, the average calculated value was \$1,575 per house. The cash cost was 44.4 percent of the house value, and the home contribution amounted to 55.6 percent. It is obvious that the varied conditions existing in different communities complicate the problem of farm housing, and no uniform basis of size, quality of construction, or cost can be established that will meet the housing needs of any considerable number of families.

The average cost of medical care for the Illinois farm families keeping home accounts during the past 9 years has ranged from \$41 to \$86. In the 1937 accounts of the 280 families medical care was the eighth item on the cash expenditures records and averaged \$72.

Further information on the costs of sickness and medical care was obtained in a study made by the Arkansas Station. In a typical community of the Ozark section, 322 families were interviewed as to the state of their health, the costs and type of medical service utilized, and their indebtedness for medical care. Information was also obtained from persons professionally connected with health services and from the records of the State health department. The families were largely farm owners, with a few large landowners and some townspeople who were engaged in both farming and business. The community, with a total population of 1,292 persons, had one resident doctor and four practical nurses but no dentist and no hospital. The entire county had only three registered nurses. About 25 percent of the families had total incomes under \$250 and only 1 percent had total incomes over \$3,000 a year.

The reports from the heads of the families showed that 73 percent of the people were in good health, 10 percent in fair, and 17 percent in poor health. The most illnesses occurred in January and February and the least in October and November, with influenza, colds, stomach trouble, rheumatism, and heart trouble being the most common ailments.

The average yearly expenditure for medical services was \$26.67 per family, or \$6.65 per person. Of that amount the services of a physician took 44.8 percent; unprescribed medicine, 19.9; prescribed medicine, 17.6; hospital services, 5.5; dental care, 5.1; practical nurses, 4.1; chiropractic services, 1.2; registered nurses, 0.8; midwives, 0.5; and ambulances, 0.2 percent. Over half of the families had used the services of a physician, about one-seventh had visited a dentist, one-eighth had practical nursing services, and about one-twentieth had been in a hospital during 1936.

The highest-income families enjoyed better health and had fewer sicknesses, and, in addition to a higher expenditure for medical care, they also spent more for prescribed medicines and used less home and herb remedies. Although the low-income families spent fewer dollars on medical care it represented a much larger share of their incomes, and over 40 percent were in debt for medical services as compared with about 15 percent of the families in the higher-income groups. Two serious obstacles to adequate medical care for the low-income families were the lack of transportation and the poor means of communication.

With clothing expenditures of farm families ranking among the "big four" of living expenses, along with food, household operation, and the family use of the automobile, the studies at the Wisconsin and Missouri Stations on expenditures for textile fabrics and clothing are particularly interesting.

The character and extent of home clothing construction and the costs involved in home manufacture were obtained in a study conducted by the Wisconsin Station on the clothing expenditures of about 900 persons in some 200 rural and village families living in central Wisconsin. The value of the living which these families were able to secure ranged from about \$500 to \$1,300. While the clothing expenditure for the typical family of four persons was about \$85, the average clothing value of \$102 is really a more significant figure, since it includes, in addition to actual expenditures, the value added by home construction and the clothing gifts received by the family. As might be expected, the number of garments made at home for men and boys was so small that it added almost nothing to the average value of the clothing acquired during the year. Nearly two-thirds of the women and girls, however, had some clothing constructed at home.

The costs of a number of home-made garments for women and children were compared with the prices of comparable commercial articles. The amount paid for the materials, together with the calculated cost of the equipment used, including repairs, depreciation, and loss of interest on investment, was taken as the cost of the garments made at home. No consideration was given to the home labor costs. The costs of the ready-made garments were the average prices

advertised by various stores and mail-order houses where the families did their buying. The probable differences in style, finish, and durability between the two types of garments were not considered.

Cotton dresses made at home represent a saving of almost 65 percent, and wool or part-wool dresses of 61 percent. For cotton slips and pajamas or nightgowns made at home the savings were about 47 and 50 percent, respectively. The saving in home-made undergarments amounted to only 30 percent, and in aprons to 40 percent. The amount of saving appears to depend largely on the type of garment, the amount of hand work which has to be paid for in the ready-made garment, and the readiness with which mass-production methods may be applied in commercial construction. The saving also appears to vary to some extent with the age of the person for whom the garment is made, being greatest for the older girls and women and decreasing with the age of the younger family members, so far as outer garments are concerned.

The Wisconsin Station investigators were interested to find that in families of seven or more persons, the tendency to make and make over clothing in the home was much greater than in the smaller families. The opportunity of purchasing relatively cheap ready-made garments may be the reason that more home sewing was not being done by the families. Other factors probably are the absence of sewing machines in many homes, and the lack of skill in sewing, as well as the pressure of other household duties.

The replies made by 40 homemakers to a questionnaire sent out by the Missouri Station give an indication of the demand for textile fabrics for various purposes. Most of the homemakers were buying cotton materials for curtains, preferably a marquisette. Wool blankets were much preferred to part wool or cotton. Durability and a soft texture were considered the most important qualities to look for in cotton sheeting, while durability, softness, absorbent capacity, and ease of laundering were considered in purchases of ready-made towels of cotton turkish toweling. For dish towels the greatest demand was for cotton ones made at home from flour or sugar sacks. The greatest demand in dress slips was for ready-made pure dye silk ones costing less than \$2 apiece, although many of the women liked rayon slips and some favored cotton ones if made of preshrunk materials. The majority of the women preferred ready-made house dresses costing less than \$2. If they made their own house dresses they wanted preshrunk, fast-color cotton fabrics costing less than 30 cents a yard. Afternoon dresses of pure dye and washable silks priced at less than \$20 were very popular and there was a great demand for ready-made cotton afternoon dresses. Among the complaints registered by the participating consumers were the difficulty in distinguishing between silk and rayon fabrics in the absence of adequate labeling, and the poor seam construction that can be found in ready-made dresses at various price levels.

The major demand on the cash income of the farm family is the expenditure for food, even with a large home-production program. During the past few years there has been a definite trend toward better planning to meet family food needs. In many farm homes the family now estimates the quantities of different foods needed for

satisfactory diets and then decides what and how much might well be produced at home and what and how much purchased.

The South Carolina Station has kept detailed weekly records of the foods eaten by groups of farm families living on the lower Coastal Plain and in the upland sections. The white and Negro families living mostly on tobacco farms in the lowland section raise less food for home use and have poorer diets than do the upland farm families, which are mostly white, independent, small farmers raising much of their own wheat and corn and having gardens and cows. Their meals are based on milk and cereals, and include typical southern foods, such as sweetpotatoes, greens, corn meal, and sorgo sirup. Because the upland farmers produce a variety of foods their diets in general are good, even when their cash incomes are low. The lowland farmers buy flour instead of growing their own grain, and have very little milk but more lean meat. The investigator is of the opinion that most of the low-income families on poor land could have adequate diets if they would produce more of their own foods, especially the "protective" foods like milk, green and yellow vegetables, fruits, and eggs.

At the Mississippi Station dietary records were kept of white and Negro farm families representing both landowners and tenants, half of them living on good soil and half on poor. These records show that the white families living on good soil have better diets than do those living on poor soil. The former are practically all landowners, and usually have a vegetable garden and an orchard and their own cow, chickens, and pigs. They make their own corn meal and table sirup, preserve their garden products, and put up wild berries for winter. Naturally they spend less money for food than do the white families living on poor land. The latter are mainly tenant farmers who produce much less of their own food, and through lack of money are unable to buy enough of the "protective" foods. Probably because of the uncertainty of their tenancy, few of them are interested in planting fruit trees or a garden and they have fewer chickens and pigs. Because their cows are inferior and have poor pasturage, their milk supply is often low. Because their pigs are inferior their meat is scant—too high in fat, too low in lean.

The Negro families living on poor land are more likely to be landowners and generally have better diets than do the Negro families living on good land. The latter are usually tenants on farms devoted to cash crops such as cotton and tobacco. For this reason, and also because the owners of the good land are rarely interested in allowing the tenant to use even a small part of it for a garden, orchard, or pasture, such families cannot produce much of their own food, and since they have little with which to buy food their diets are very poor. The groups of investigators at both the Mississippi and South Carolina Stations have reached the same conclusion, namely, that it is not so much the land as the way the land is used that influences the diets of farm families.



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